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Copies of the Year Book, Regulations, and Candidates' Certificates may be had on application at the Society's House, Kensington Gore, London, S.W.

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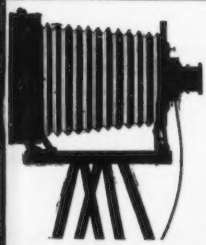

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Afternoon Meeting, Thursday, January 21.—In the Map Room, at 3 p.m. Exhibition of Historical Maps of the Humber Region, with remarks. By T. Sheppard.

Lectures to Young People.—No more tickets available.

Year-Book.—The Year-Book for 1914–15 is ready, and will be sent free to any Fellow applying for a copy to the Chief Clerk, Royal Geographical Society, Kensington Gore, S.W.

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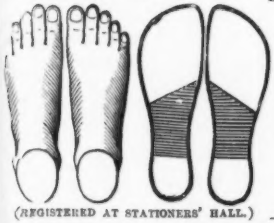

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OCT 12 1915

The

Geographical Journal.

No. 1. JANUARY, 1915. Vol. XLV.

THE GEOGRAPHY OF THE WAR.*

By HILAIRE BELLOC.

In speaking upon such a subject as the effect of geography upon this war it would have been possible, and perhaps more interesting, for me to have dealt with the matter in its particular national aspect; and that particular and national aspect is, of course, for us in this room the problem, first, whether, for the first time in the history of the world, a naval power can in a critical duel with a military one permanently maintain the advantage with which it necessarily begins by its control of communications on the sea; secondly, whether a highly sporadic, separated heterogeneous system of dominions can survive a universal strain; and thirdly, whether seas so narrow as those which defend this country can really be dominated, as Captain Mahan presumed some years ago they could be, by a modern fleet.

That triple strategical and geographical problem is, of course, by far the largest issue in the present war, and the gravest geographical question which the war will test. But I shall not deal with it to-night because I am not competent to deal with it. No one can deal with that—the infinitely greatest issue before us in the effect of geography upon war—save a man who can talk with confidence upon naval warfare, which I cannot.

I am not even going to discuss the geography of the campaign as a whole in East and West. Nor, save in the briefest possible terms, to touch upon what may be the effect of geographical conditions upon the next developments of the war in the months just before us.

To tell the truth, I have confined what I have to say to a very small and a purely academic subject: to the campaign in North-Eastern France

* Royal Geographical Society, November 9, 1914. Maps, p. 96.

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as illustrating certain very obvious and very elementary points in the science of Strategics. This war, upon which the happiness of all our children and our children's children must depend, I desire you to regard for the moment with a complete detachment, as though it were a mere object lesson in the elements of strategy; because the science of strategy (if indeed it is a science—for it can hardly be dignified by that name) is among the most interesting of occupations to which a man may turn in his leisure, and it is fortunate, in one sense, that the intelligence of the average educated person, who has not learnt anything of military history at school or at the university, has been awakened to this subject by the portentous events of this year.

The first question we have to ask ourselves on the campaign in France as an illustration of strategy is this: How does geography affect the war?

Nearly everyone reading history has wondered how geography affects war. He is told in history that a range of mountains, a river, or what not, have such and such a "strategic" value, but he is used to modern travel, under mountains, across rivers, without perceiving or testing these obstacles. His maps are political and arbitrary for the most part. He has no experience to guide him in the meaning of that phrase "strategical value." The modern civilized man has great difficulty in appreciating why geographical conditions still dominate war.

I interpret the words "geographical conditions" to mean those accidents in the varied surface of the earth which are not due, in any appreciable degree at least, to the action and the intelligence of man.

We all understand how a road, a railway, still more how a fortress or trench may interfere with or help the progress of a campaign or an action. But how do general geographical conditions affect them? I say again, that that question, which would seem so obvious to men living under simple and primitive conditions that it was hardly worth asking, does very often puzzle your civilized modern town-dwelling man. Yet it is true that geographical conditions affect a modern campaign almost as much ultimately as they can have affected a primitive campaign.

There are two main aspects of the way in which natural features affect the movements of armies. In the first place, because the variety of the surface of the earth makes it more easy for men to move in large masses by certain lines than by others; geographical conditions provide natural strategic *Lines of Advance*. That is the first point to seize clearly.

Secondly, because of the same variety in the surface of the earth certain districts or belts are more difficult for a body of men to traverse than the average, or than the mass of country before or behind them; as, for instance, a marsh or a wooded country will be more difficult to traverse than the open and dry country before and behind it. In other words, geographical conditions provide natural *Obstacles*.

It is important to remember that both the natural *Lines of Advance* which geographical conditions provide, and the natural *Obstacle*, transverse

to such lines of advance, which geographical conditions provide, are, especially in modern times, relative. There is nothing absolute about them.

It is particularly important to remember this truth in the case of the Obstacle. There is no obstacle which *cannot* be traversed by an army. There is no obstacle in the history of the world which has utterly prevented, at all times, the passage of an army. But when you consider the importance of time in strategics, when you consider that the factor of time is (other things being equal) the all-important factor in war, making for victory or defeat, then you perceive what an Obstacle means in strategy. An obstacle held by a lesser force will always be able to check an assault made by a somewhat larger force. To maintain that condition indefinitely would be impossible, and would certainly not give victory to the force defending. An obstacle only gives *time*, and only a certain increment of time, to a defending force.

Having proved these definitions, let me deal first with the *Line of Advance*.

There are two great geographical conditions which have determined the line of advance from the earliest times to the present day, and which continue to determine it. They will continue to determine it until, or if, traffic by air becomes general and feasible. Until men and munitions can be conveyed in large quantities through the air, geographical conditions will determine that your Line of Advance will always preferably be (1) over plain country, so long as it is not marshy, rather than over hills, and (2) will normally follow a river valley.

To this you may add another very important consideration, which is lost sight of, I think, too often when men are writing even military history. Your Line of Advance will also be determined by what is known in military terminology as *The Defile*.

A *Defile* is the English for "*defilé*," which is simply the French word for something "spun out"—for you know that all our military terms are borrowed from France or Rome. Where a large body of men advancing on a certain front is compelled to contract that front and to "spin out" its advance, or to retreat by a much thinner or congested line than it normally occupied, then it is said to "defile," or to "pass through a defile." For instance, a single bridge over a river is a "defile" in a military sense. A pass over a mountain, a causeway across a marsh, a road cleared through a forest, all these are defiles. Now your line of advance does not only depend upon your having flat country rather than hilly, it does not only depend upon your following a river valley, it is also strictly conditioned by these defiles. If your objective carries you through two lines of hills, you will try, of course, to follow river valleys up one side and down the other, but you will also be conditioned by the easiest passes across those hills. If your advance has later to negotiate, say, a marsh, you will seek a hard way across it, and your line of march will be traced, on the whole, from the first to the second of these

"defiles." When you ask why, even under modern artificial conditions, the river valley and to a certain extent the natural defile still thus determine a Line of Advance, the reason is the old Greek saying, that "the present is rooted in the past." Much the easiest way of conveying weights or large bodies of men in very early times was the broad stream that moved along of itself, that required no mending, required no attention. It also provided the first necessity of life, which is water. Man under simple conditions moved in his campaigns, as in everything else, along rivers. Upon these rivers, especially at certain *nodal* points (that is, points which are "knots," or meeting-places, where other forms of communication—as a tributary—cut into the river), there grow up markets, places of supply and places of exchange, which are towns. And when usual complexity has so far developed that roads begin to be made, the road comes into existence in order to link up these towns. Therefore the road will also follow, as a rule, the river valley. If this be marshy the road will follow parallel to it at some distance on the higher ground. But it is still the river that determines the great roads, by determining the sites of great towns, and the most modern developments curiously show how in this instance our present is pinned to our past. The railway when it came was constrained to the river valley because it was constrained to linking up the great towns. So was petrol, for petrol was constrained to the road, and the road had come down the river valley even before the railway had. It so happens that in this campaign you have a peculiarly emphasized example of this elementary piece of historical strategics. A series of river valleys have formed not only the main but the only Line of Advance for the German invasion. The middle Meuse, the Sambre, the upper Somme, and the Oise have provided it; and on that line still largely depends the issue of the war in the west. It was the road, the canal, the railway following down that line of rivers which made possible the enormously rapid advance of the main German army upon Paris; the retreat of that army followed that same line as far as Soissons; and to this moment that line is the principal avenue of communications—that is, of supply of food, munitions, and all that is necessary to an army—from the bases in Germany to the German front in Northern France.

Of defiles, we have not in this campaign anywhere as yet a strong *natural* instance. We have some few in the Ardennes. But in the general strategics of the war, what with the open plains of the eastern theatre, with the multiple railway and road system of the western centre, defiles are hardly to be recognized.

Had the German plan included an attack by Alsace Lorraine you would have had excellent examples of defiles, but this front was left aside. There is one very interesting example of what is in practice a defile, and one on which a great deal of this war has turned, but which is not strictly speaking a geographical or natural defile, for it is only partly

produced by geographical, and partly by political conditions. That example is the defile between the Dutch frontier and the heights of the Ardennes, which gate was blocked by the fortress of Liège. There you had a little gut, a little "neck of the bottle," only ten or twelve miles wide, through which the vast advance of what is believed to be by some as many as 14 army corps—certainly more than 10 army corps—was organized by the Germans through the Belgian plain. It is only a defile because the Germans did not chose to violate an arbitrary political boundary—that of Holland. It is not a natural defile. There have not even been natural defiles in the shape of fords, because the one great obstacle that has been used in this war, the river Vistula, is not fordable at any of the points where the Germans attempted to cross it. We may say that so far as Lines of Advance are concerned this campaign has particularly illustrated their character by the necessity the Germans were under of using the Belgian plain rather than the Ardennes, and by the necessity they were under of following the middle Meuse, the Sambre, the upper Somme, and then the Oise, down to the neighbourhood of Paris, and to keep that line as their main line of retreat and communications on their retreat.

When you next consider the *Obstacle* you may say, with more justice than can be said of most of these generalizations, that there are five great strategical obstacles presented by nature for defence against the advance and five only. These are, in the order of their importance: 1. The river, in which you include the arm of the sea and the canal; 2. The Forest; 3. Hill Country; 4. The Desert; and 5. The Marsh—and of these by far the most important is the Marsh.

It is probably marsh which as much as anything will prove to have turned the history of the campaign in the west. Marsh along both sides of and behind the river Yser, between Ypres and the sea, which line and obstacle for some reason no one has been able to point out (I can only conclude it to be because things are as silly as they look), was attacked by the German commanders in an attempt to reach Calais. It is possible that the failure of that attack will determine the campaign in the west.

Let me very briefly recapitulate these five types of obstacle, because on understanding them will depend a great deal—a comprehension of this campaign or indeed any other.

A river is never a *permanent* obstacle, never has been in the history of any war which you can call to mind. A river is very valuable as a temporary tactical obstacle. An army will hold a river for a short time to cover a retirement, or better still while it is preparing a defensive position upon hills beyond it, but a river never has been permanently held for a long time, for the simple reason that man, in all stages of his development, has been able to cross a river fairly easily if there were no marsh upon either bank. He could always swim. He must at all stages of his development have discovered a quantity of objects by which he could float across water—the log, or inflated hide.

The Forest as an obstacle comes next in importance. It is a more serious obstacle for a reason which, like so many things concerned with the elements of strategics, modern people miss because they are used wholly to artificial conditions, and almost wholly to conditions of peace. There are very few men indeed who have been several miles across wooded country without a road or a path. If you try to get through the Ardenne country, for instance, from the valley of the Meuse to the valley of the Sémois, leaving the roads, you will not progress at much more than 1 mile an hour. Underwood, undergrowth, loss of one's way, lack of any provisions or food or people, hundreds of other conditions make the Forest a serious obstacle; and in practice, with the exception of certain types of clear and sparse woods—and even then for any force except cavalry—forest condemns an army to the defiles of its few roads.

Hills, the next type of obstacle, vary in almost every degree, and in the chief case are more formidable than forests. The Pyrenees have compelled all armies throughout the history of the world to three or four very narrow defiles: the Alps to perhaps a dozen. Strategically, only large ranges of hills are an obstacle. Tactically for use in battle, in action, a very small rise, especially to-day, is more valuable than a large one. The tactical value of such obstacles resides in the elementary principle of holding a crest against some one who, to attack you, must run up the slope before he can reach it. The crest of a rise has always obviously thus provided defensive opportunity.

The Desert has not come much into the history of campaigns. It may come into the history of this campaign in a most interesting fashion. When or if it is decided that a considerable Turkish force shall advance from the frontiers of Syria on to Egypt and against the obstacle of the Suez canal, we shall have a very sharp proof of whether or no modern conditions have greatly modified that most difficult of ancient obstacles —a stretch of almost waterless sand. Between Akaba and Suez you have only one provision of water in 150 miles. On the road by which Napoleon and every one else has marched between Syria and Egypt, the sea road, you have only three provisions of water in 120 miles. Whether the use of petrol traction or of a light railway or of any other modern mechanical invention will be able to overcome this difficulty for large bodies of men we have yet to learn.

Finally, there is the Marsh; and the only reason why writers have as a rule not wakened up to the all-importance of the Marsh, both in strategics and tactics, is the comparative rarity of its presence in Western and Southern Europe. It was the marshes in the West of Russia that determined the whole plan of the invasion of 1812, and the Marsh, which we thought would have no effect in this campaign of a highly civilized time and over a highly civilized territory, has reappeared with immense effect in the fighting upon the Yser. Probably under modern conditions nearly all obstacles are tactically opportunities for entrenchment.

A river is an opportunity for stopping a man for a short time while you entrench beyond it; the crest of a low hill is an opportunity for entrenching against the man who would run up the hill against you. *But in marsh you cannot entrench.* It is pretty well the only soil except granite in which you cannot. We have had a very interesting example of this in the last few days in Northern Flanders.

Having said so much, I would like to make one or two points in connection with this campaign which the map will show you. If you look at the map of Europe, you will see that all the centre is a mass of highland, and that to the north runs a great plain. Industrial and densely inhabited Belgium is the continuation of that plain, and it reaches down towards Paris, the centre of the life of the French people. You will perceive that the high-road for armies trying to reach Paris exists, and has nearly always existed, upon that line of invasion through the flat country. The next point to note after this great northern plain is to the south of the hills, the long east and west river valley of the Danube, offering peculiar facilities for the passing of troops from east to west by modern railway communication. The people living in central Europe have therefore a singularly good opportunity for fighting both those fronts east and west, and that especially under modern conditions.

Next there is a valley of invasion leading directly from that northern plain right on to that essential Paris: it is the valley of the Oise. If the invasion comes round south of the Ardennes then there is against Paris another valley of invasion, that of the Marne. Finally note this very interesting point. The German peoples have one parallel line of rivers after another to act as obstacles transverse to an invasion of their country. It is a singular combination of geographical circumstances in favour of the enemy. The Vistula on the east is backed by the Oder. On the west you have the Meuse and then the Rhine, and then the Ems. We must not exaggerate the value as an obstacle of a river, but such a succession is formidable, while there is no river valley leading into the heart of Northern Germany to counteract this succession of river valleys, obstacles against an invasion into the heart of modern Germany. Map No. 1 shows relief by contours and tinting, with the principal towns and railways. Paris, note you, is necessarily the objective of any invasion of modern France, and observe with what singular ingenuity nature has arranged a Line of Advance. There is the Oise. Hardly has that ceased when you have with the Somme and the Sambre a line leading you to the Meuse, and there to the bases of German provision upon the Rhine and behind the Rhine. It is a direct line of advance save for the rather deep gorge between Namur and Mezières, and it is a line which has accompanying it the main railway and a main road. To that line the German invasion has been pinned, and the German retreat also with its communications. See how the towns run in a series along that line—Liège, Namur and St. Quentin, Compiègne, Paris. The next thing you see on the

map is the way in which the Belgian plain is a road of advance for the German armies if they were to go through the north at all. The country of the Ardennes, below that plain on the map, the great triangle to the south, is not only highland, but highland of a very difficult character. There was indeed for some years a school of strategists who believed that the Germans would attempt invasion through the Ardennes, and this scheme was generally called the "Ardennes March." People used to discuss whether it was possible or no. It was possible of course, a modern army could get through, but to debouch from the woods on the map across the rivers Meuse and Somme would have been difficult, progress would have been slow, and advantage would have been taken at once of the invader's difficulties then. It was so fairly obvious that the Ardennes march would not be undertaken that many critics were ready years ago to prophesy that it could not be. I remember doing so myself in a public print, and laying it down that the Ardennes march could not in reason be undertaken by the enemy. What they could do was to advance in upper Lorraine; though it is marked as highland it is easy going and has great roads and a railway system attached to it, but it was supposed to be blocked by the French barrier fortresses, before it was discovered how easily modern fortification falls to the march of the howitzer.

There is also an easier line of advance up the valley of the Moselle and through into Luxemburg and Sedan, but hardly with room enough to deploy any very considerable force, so when the German Government said, as they did say to our Ambassador, that it was *necessary* for them to go through the Belgian plain, they were talking sense strategically, even though morally they were talking nonsense—just as if I were to say that I cannot take your watch if you button up your coat. If they wanted to destroy French power they could not destroy French power on the front Verdun—Belfort, therefore they had, they said, to violate the general principles of international morals, and cross the Belgian plain. Before I leave that head, let me point out that though this is the main avenue of advance dictated by nature on to Paris, there is yet a secondary avenue which is very important. It runs from the Oise to the Somme, up on to Brussels, and then from Brussels eastward through Louvain, linking up of no particular series of rivers, and is not a geographical but a purely artificial development due solely to human energy. You had your great town in Brussels, your great town in Paris; and the railway sought over the easiest country the shortest line of least resistance between them, so it left the Oise altogether.

An inspection of the map will show you the way in which those river valleys have produced the political centres which roads exist to link and which armies march through. Look at all that line of towns from Mons down the Oise to Paris. Note how all the names which you are familiar with in this campaign are right on that line, and note

further how, with very few exceptions—Rheims is one—the main towns are thus strung along the river valleys. The whole defence of the Rhine depends upon a line of the same sort, and there is a point well worth emphasizing which those who have not gone into military history are sometimes at a loss to understand—why towns thus determine the march of armies. It is not only the political importance of a town as an objective—the fact that when you have captured a capital you have put political pressure upon your enemy—it is also that the town is a *depôt*. The great town contains resources of provision which an army can use; shelter, which is very important; the rolling stock of railways; petrol. More than that, the great town provides you with all sorts of opportunities for obtaining every commercial necessary. It is a market: it is an economic centre with the machinery for controlling currency as well. Notice another very interesting point. The great town has never been destroyed even in this campaign. It has not *paid* the enemy to destroy it. There is one further point this campaign may develop before it is over, and that is whether the great modern town can resist. We have had no test of that, and I think opinion is still wise to be in doubt, holding its judgment between two extreme theories. As we are living in a very large town it is just as well to know what those theories are. One theory is that your very large urban agglomeration is an easier prey to an organized army than a smaller one. Being chaotic, unco-ordinated, a dust of humanity, an unprepared target of large size, it is an easy prey. The other theory is the exact opposite of this, the extreme view that a large modern urban population, really determined to prevent occupation by an enemy, though it would suffer enormously of course, would yet probably succeed in preventing such occupation. I incline to the first of these two, because I do not see what your great modern town is going to do against long-distance artillery. It seems to me you could reduce it just as you could a smaller place and just as thoroughly, and it is morally weaker than your smaller town, for it is less co-ordinated. At any rate, towns not only mark the line of advance, but they also are those depôts by which armies must march.

Finally, it is the river systems which, as I have said, give you the great modern railways. To show you how true it is of this campaign look on the map at the railway communication of the German front ever since that front was pushed back to the line of the Aisne. The line of the Aisne runs through Champagne, and the line along which the Germans entrenched themselves was just behind the river from Noyon past Soissons at Berry-au-Bac. The line up the Oise is their main line of communication; the other parallel with the Aisne itself is their secondary line of communication. You should also note, because it is of importance, that there is a subsidiary line going along the valley of Suippe river, and not reaching quite to the Meuse, which feeds the whole German front. Now the importance of noting those three railway lines thus marked,

is that you may be certain in all the future developments of the campaign no force will long stand without a railway parallel to its line and behind it. The German stand along here has been a stand along a line which has railways to feed the army parallel to it and behind it, and my reasons for thinking at the present moment that the German armies in the east are not going to stand permanently on the Vistula, but more probably nearer the frontier, is that on the Vistula they have no railway communication parallel to and behind their line, whereas they have such a line near their eastern frontier, and the importance of good railway communication parallel to your line and just at your back is this, it carries munitions to your heavy artillery. You can hardly work heavy artillery at all—hardly deliver a sufficient amount of shell to do the work you desire it to do—unless you have railway aid. You know, for instance, that the Germans lost a great deal of their heavy artillery just between the East Prussian front by Osowics, although they had one railway leading *to* Osowics, and they lost it because they had no *parallel* railway to maintain their line before the fortress. If you look at the modern map of Europe, you won't get a defensive position in this campaign which has not got a parallel railway to serve it. Those are the two lines of German communication, and for these the fight went on from the middle of September to the present moment. There was a perpetual attempt for the French to get round to these railway communications from the west, but the German superiority in numbers was always too much for them; the Germans pushed the French back from the neighbourhood of the railways perpetually, until at last the line reached the sea. As you see, our present defensive line, which runs north and south, is a long way from being able to attack the main line of German communications; and short of some collapse, which is very unlikely, I think, all the German line along the Aisne will be able to retire at its own time and at leisure by its two main lines of railway. The line through Luxemburg is rather more in peril, because the forces here on both sides are small; a reinforcement of the garrison of Verdun, if the German army eventually began to retire on a stroke from Toul, might cut that line, but the line at St. Quentin, I fear, there is now no hope of cutting; by that I think the mass of the enemy can always retire in safety.

I will try and show you how the Vistula and the San determined the whole battle in the Eastern front. All along the San and the middle of the Vistula, the two forces, Austro-German and Russian, faced each other. The front was absolutely determined by the rivers, and the only place where there was a chance of deciding things one way or the other was at Warsaw, and if the Germans had got Warsaw before the Russians had come out it would have been a battle for the two rivers alone. As a matter of fact, round about October 20, the Germans were beaten in front of Warsaw, and that led to the retirement of their whole line; but the rivers still determined that line.

A still more interesting example of even a little river making a vast tactical difference as an obstacle is the Ourcq.

If you want to understand how Von Kluck got away by that magnificent march of his and saved the whole of his army, you must note how he used the Ourcq. Von Kluck had come down the valley of the Oise, to the neighbourhood of Senlis. The mass of his force was here. His left was reposing on the Oise. That was on the anniversary of Sedan, and he had in front of him the 6th French Army and the British contingent, and still retreating before him the 5th French Army. Those units represent roughly the superiority in numbers which he had over the force in front of him, between him and the fortified zone of Paris. It was just at that point, on September 3 and 4, he discovered, whether by spies or by aircraft, that Joffre had hidden behind the fortified zone of Paris six corps, 240,000 men.

When Von Kluck had got as far as Senlis, having driven everything before him, this reserve of 240,000 men behind Paris suddenly threatened his army. Combined with the British contingent and the 5th and 6th French armies, it would not only have been larger than Kluck's, it would have been right on the flank of it; now thus faced with superior numbers in front of him unexpectedly at the decisive time and place, Von Kluck "took counsel," as Cæsar says of Severus, "with his own great soul," and he did an amazingly daring thing. He said to himself, "If I retreat, which is what all the text-books would tell me to do, back up towards the valley of the Oise, I shall carry back with me the whole of the German line, and I shall be the man who will be remembered as having caused the campaign to fail." He would not do that. He took the infinitely more audacious and terrible resolution to do as follows: to change direction, in itself a very lengthy and difficult process, and whereas he had been marching south-west to turn south-east, at right angles. In doing so he marched right across the front of the sixth French army, the British contingent, and the fifth French army. He marched to join the Prussian army next upon his left, and combined to break through the French lines somewhere on that line, hitting in the neighbourhood of Provins and breaking through. It was a perilous experiment, and on the night between September 5 and 6, while he was in what the French call "En flagrant dèlit de marche," Joffre went and saw French and proposed the counter offensive for the next morning. The counter offensive was taken all along the line on September 6, and Von Kluck was within an ace of disaster. But he put all his best troops to protect his rear and flank along the valley of the Ourcq. I do not know whether any of you know it. It is a beautiful little ravine in the neighbourhood of Meaux. He crowned all the heights of the ravine on the west side with his best troops and told them to fight against what would be gradually increasing and at last overwhelming odds, until his main body had got away. They fought so well that they took several French guns and some prisoners, and held that line for over forty-eight hours, while the main

body crossed the Marne and pelted away northward with the British contingent and the French army after them. The whole thing had been so cleverly done that the mass of Von Kluck's army got away with very slight loss in guns and men. There you see what is meant by the obstacle of a river properly used.

The tactical use of a slight rise of a range of hills you have very well illustrated in the positions which the Germans took up on the Aisne mountains, about 90 miles, when that great retreat was over (see map No. 2). The map shows the forest of the Argonne; along the river Oise is the main line of German communications; filling in the angle at Compiègne, is the end of the line close by Noyon. There is a little forest called the Forêt de Laigue. All the bit just north of Soissons is a range of chalky hills about 300 feet high. Beyond that to the east there are two light swells of land not more than 100 feet above the water-level. There was evidently at first some hesitation on which of these two swells the Germans would stand. They dug their trenches along that plateau, then crossed the river at Berry, and then carried the trenches on eastward in front of Rheims, and so along that swell of land to the Argonne, and those trenches in the main they have been able to hold ever since, but only because they were able to check the pursuit by the line of river here—the Aisne. That gave just the time to complete what was probably already a fairly prepared position—an excellent illustration of the way in which a slight rise is a formidable tactical position of defence.

Of forests one has little to say save in the case of the Argonne. The wooded land in all the advance on Paris is confined roughly to a few spots: the advance misses them. Taken as a whole, the attack on Paris from the north did not bring in the strategical, and very little brought in the tactical, importance of forest. But there is one forest in the western field of war which does most singularly illustrate the value of wood, and that is the Argonne.

The Argonne has probably saved hitherto at least one German army. The Argonne ends the great defensive line across Champagne and makes perpetually difficult the combination of the German armies across Champagne for 90 miles. The Argonne is a low ridge of clay about 300 feet above the plain on each side, and it is only crossed in three places by road, here, here, and just out from the top of the map there. It is only crossed in two places by railway; one that goes from Rheims to Apremont, and the other from St. Ménehould to the great fortress Verdun. In history you know it has played a great part. During the great retreat of the German army in Argonne the Crown Prince was foolish enough to lose the main road across the Argonne from St. Ménehould to Verdun. His headquarters were at St. Ménehould, and he was at that moment investing Verdun. He fell back as far as Mont Faucon, with the result that the only road which he commanded, and even that he did not thoroughly command, was the middle road through the woods, and for

possession of that road the fighting has gone on ever since with very close trench work in the woods to the south and north of it. You are always hearing of the wood of La Guerre—which is to the north of the road, and of the wood of La Chalade—to the south of it.

I will close by showing you (see Map 3) what has determined the last phase of the war and may possibly prove the turning point of it altogether —that great example of the use of marsh tactically in modern warfare, the valley of the Yser. For the town of Ypres the British contingent is just now fighting hard (see Map No. 3). Through Dixmude to the sea runs the canalized water which now bears the name of the Yser (though the true Yser runs a little further to the west). Note the modern artificial tactical point, the railway, which is largely embanked above the marshy country. To see how marshy that country is, every one of those fine lines is a more or less broad water-ditch. I know that country by heart and I can put it in this way—there is no ditch there of all those thousands which a body of men could cross without artificial means. You see that labyrinth of water, and what an obstacle it is. No one can tell who ordered that march on Calais or why. The strategical way to re-open the road to Calais, to "uncover" the whole of the sea coast, was to attack in force near La Bassée. If the enemy had massed all his men at La Bassée he might have got through. But somebody ordered the march along the sea coast, and the attack was made between Dixmude and Nieuport, right on the marsh over a front of about 12 miles. In that attack, which has now finally failed, the enemy certainly threw away the equivalent of an army corps. He certainly did not lose less than forty thousand men hit or caught. It was an impossible task.

They tried it in every form. They tried it first of all in the seizing of two bridges; they managed to get those two bridges at an enormous loss of life; they next took this re-entrant angle, when the Belgians, caught between the fire on either side, fell back: they pontooned the part above Dixmude and got over. After fighting eleven days some of their advanced posts just touched the railway line, and there, just as the effort was exhausted, all this country was flooded. It is easy to say so after the event, but many critics were saying it, myself among them, during the action *the thing could not be done*. The marsh was too much of an obstacle. Why it was attempted to force it at all with all that mass of waterways beyond has never been guessed—on our side, at least. Perhaps the answer was what is so generally the answer in human life, that a thing is as silly or even sillier than it looks. That attempt to overcome the obstacle of marsh was due to a political miscalculation and not to a military order, and I can only pray that further political miscalculations of the sort may continue through the rest of the campaign.

The PRESIDENT (before the paper): It has seemed to your officers that we could not begin the session better than by asking Mr. Belloc, whose weekly

articles most of us have followed with interest and profit, to tell us something more to-night about the field of war in the west. For many years I have watched Mr. Belloc's literary career with particular interest. For in whatever he has written he has shown in a very remarkable way a genius for geography —for bringing home to his readers not in hybrid, so-called scientific, terms, but in classical English, the controlling features of the regions he has wandered in. Whether it has been on the road to Rome, in the heart of the Pyrenees, among the skirts of the Algerian Atlas, or along the Roman roads that pierce the familiar wilds of Sussex Mr. Belloc has made me see over again things-seen, and I am confident, therefore, has enabled his less-travelled readers to form vivid and true impressions. For his present task he has the additional and singular qualification of being a veteran of the French army as well as an ex-member of our own Parliament.

Sir THOMAS HOLDICH (after the paper): So clear and so fascinating has Mr. Belloc's lecture been to us that I think no military officer can possibly quarrel with his conclusions. I have very little to say and absolutely nothing to criticize. But if there is one part of his lecture which appears to me a little more unconvincing than another it is this, that he expressed an opinion that the conditions of modern warfare have in no way altered the relations of geography to the incidents of a campaign. Now, I think that rather remains to be proved. We have learnt lately to see armies drawn out under quite different conditions to what they were in the days when we were taught our military duties. Instead of one army hunting another under most picturesque circumstances through wide stretches of country until the two met, and (more or less by means of information obtained by cavalry scouts) one side out-manœuvred the other, we have now two long lines drawn out across the country, extending for hundreds of miles, in which it appears that many of the old principles of strategy must be entirely lost. These armies, as they gradually progress forward, do not hunt for narrow openings or take particular account of obstacles. They move straight on, and, if they can, they move straight to their front. Whatever natural geographical obstacles may be in front of them they have to take as they come, and they succeed in dealing with them without recourse to any particular lines of advance which would offer easier methods. We have seen that very well exemplified in the Eastern area of this war where the Russian advance in one long line has not been, so far as we know, thwarted by conditions of marshland—the particular conditions to which Mr. Belloc has referred as the most difficult of all to deal with. They have apparently not been deterred by those conditions between the Vistula and Warta rivers, although I recognize that a terrible disaster (for it was nothing else) overtook the Russian armies through the existence of marshland somewhat earlier in the campaign elsewhere. But certain campaigns are still carried out under more or less historic conditions. What Mr. Belloc has referred to as obstacles still obtain, and we still have to deal with them in smaller campaigns. For instance, on the frontier of India, we are always hunting for what he calls defiles, *i.e.* narrow openings, and we are always following more or less the lines of streams and rivers in order to make our way from the plains of India to the great plateaux of Asia; but in considering modern conditions involving millions of men, I contend that the difficulties presented by geographical obstacles are to a great extent absorbed in the general advance of long lines. I regret rather that Mr. Belloc's modesty (or perhaps want of time) has prevented him from dealing with the larger geographical problem connected with the sea. I should like to have known what he considers to be the ideal conditions, for instance, for the landing

of an enemy on an alien shore—what is the geographical nature of the coast-line which offers greatest facilities for invasion? We know that the existence of defiles or narrow outlets on the sea is just as important as it is on land. We have only to think of what the conditions of things now is as regards, say, the Straits of Dover, or Kiel canal, or the Suez canal, to be quite well aware that the great object of naval strategy is to cover those most important defiles; but I am not at all prepared to enter upon a subject which more especially belongs to naval administration. I would only suggest that we geographers should watch as well as we can what happens during this war, and connect in our own minds the geographical conditions which Mr. Belloc has pointed out to us with events as they occur; and particularly would I call your attention to the geographical features of the existing political boundaries of European States, because I think it is more than possible that ere long they may be considerably changed.

Prof. LYDE: May I venture, first of all, to say I think Mr. Belloc gave us a characteristically interesting and stimulating lecture; I say characteristically, because whatever he lectures on, or writes upon, "a Road to Rome" or a "Book of Beasts," is always interesting and stimulating. He has left to-night a little corner I should like to trespass on, the question of climate. I would like to make two suggestions to you about climatic control in this war. The first is simply to remind you that in the next three or four weeks you may have a significant comment on the fact that Russia won Siberia by transport over snow. The other is in the form of a question. How far do you think an army that lays enormous importance on entrenching itself in the most ingenious caverns is going to prosper when the iron grip of a Continental winter settles down on the European plain? [Prof. Lyde then referred to the results of the origin and environment of the Prussians and the military organization which had been forced upon them.]

The PRESIDENT: The hour is so far advanced I will not ask anybody else to take part in the discussion. We have had a most interesting evening. We are greatly indebted to Mr. Belloc for the way in which he has crowded so much into the short space of time at his disposal. I think the fact that remains most in our minds is the importance of marshes in a campaign. I have always felt with regard to means of transport that, as a rule, we fail to realize how much roads are directed by the existence of marshes wherever a country is ill-drained. This is an important consideration in tracking the Roman roads, though doubtless another reason for their keeping to high ground was that they could better see their enemies on either side.

I think the only criticisms that have been made on Mr. Belloc to-night have been that he did not cover the whole field of naval as well as of military strategy, and that he did not go deeply into the question of Eugenics as affecting Prussian militarism which Prof. Lyde has so vigorously put before us. I am not sure whether Major Darwin is here, but even if he is I will not at this moment ask him to enter into that very complicated subject. I will move a very hearty vote of thanks, which I am sure will require no seconding, to Mr. Belloc.

PORTUGUESE EAST AFRICA BETWEEN THE ZAMBEZI RIVER AND THE SABI RIVER: A CONSIDERATION OF THE RELATION OF ITS TECTONIC AND PHYSIOGRAPHIC FEATURES.*

By E. O. THIELE, M.Sc., F.G.S., and R. C. WILSON, B.Sc., F.G.S.

INTRODUCTION.—The plateaux of Eastern Africa throughout practically the whole length of the continent are traversed by one of the great tectonic zones of the Earth's crust. This zone is in general marked by a line of fracture and dislocation in contrast to the great fold lines of crustal movement, which have affected some of the other continental masses. Suess (31), Gregory (11), and others have drawn attention to the great rift-line of Eastern Africa, which has had such a profound influence on the surface features of that region. The area here considered lies to the south of the Zambezi river, far to the south of the great rift zone, but it is traversed by the continuation of the same tectonic line.

The authors, during the past three years, have been conducting a mineral survey in the territory controlled and administered by the Companhia de Mozambique, the work being still in progress. They have thus had a good opportunity for studying the geographical features of that region. Their observations, taken in conjunction with those of others in Rhodesia, Mozambique, and Nyasaland, suggest some broad generalizations in addition to the special observations concerning the district described.

There is no doubt that many important surface features have been largely determined in this region by fractures and earth-movements, but it is not always easy to decide what share is due to tectonic forces, and how much should be attributed to general erosion, guided and influenced by rock texture and structure. Nevertheless it seems clear that tectonic forces have had a dominating influence throughout the part under review.

1. GENERAL DESCRIPTION.—The region described comprises part of Portuguese East Africa south of the Zambezi river. Along its western frontier it extends from about 16½° S. lat. to the Limpopo river—in lat. 22½° S., being contiguous with Southern Rhodesia throughout that distance; roughly about 400 miles. The boundary lies in the vicinity of the meridian 33° E., save towards the south, where it takes a south-westerly trend. Throughout a great part of its course it follows a distinct geographical feature. The coast-line is somewhat shorter, and extends south from the mouth of the Zambezi to 22° S. lat. The area of the territory is estimated at 65,637 square miles, about half of which lies at an altitude of less than 500 feet above sea-level. Most of the remainder lies at an altitude of between 1000 and 2000 feet, but the isolated block of the

* Royal Geographical Society, March 19, 1914. The figures in brackets in the text refer to the bibliographical list at the end of the paper. Map, p. 96.

Gorongoza mountains and numerous parts along the frontier rise to over 5000 feet. Though large areas are often inclined to be monotonous, the scenery in the mountainous regions is bold and picturesque, and often wild in the extreme. The whole of the country lies within the tropics, though towards the southern margin; the climate is therefore hot, but there is a much more marked seasonal change than in regions of the same altitude nearer the equator. Few parts are as much as 200 miles in a straight line from the sea coast, and as the prevailing winds for a great part of the year are from the south-east, they bring coolness from the more temperate parts of the Indian ocean. Even the low coastal region is quite pleasant for at least six months of the year, but in November and December, when the hot season commences and the time for the rains approaches, the shade temperature frequently rises to well over 100° F.

Much of the hill region, however, has a pleasant healthy climate for the greater part of the year. Though the days are hot, the nights are usually cool, and often cold. In the months of June and July, at altitudes above about 3000 feet frosts are common, the temperature often falling several degrees below freezing-point. There is no reliable meteorological information for the greater part of the territory, and though some parts, especially in the Sabi valley, are rather dry, most of the region has a good rainfall ranging from over 20 up to 50 inches in the mountainous regions. There is, therefore, a large extent of well-watered country, possessing numerous fine permanent streams. The most significant feature concerning the rainfall is that the greater part of it falls during about two months of the year, when all the stream courses become powerful torrents. Stranded flood *débris* has been frequently noted 30 to 40 feet above low water. This annual rush and scour, especially on steep slopes, must have a much greater erosive effect than in regions where the rainfall is more evenly distributed throughout the year.

The whole region supports a good growth of vegetation. Forests, though often somewhat of a thin and open character, extend almost continuously throughout the country. There are, however, some extensive treeless belts on the plains of the coastal region. On the whole, the country is very well timbered and possesses some areas where there is a dense tropical forest. There are also large tracts of jungle, which are the result of a custom of the natives, extending over a prolonged period, of deserting their old farms, and breaking new ground by clearing the forest. The old farms rapidly pass into the state of a jungle of scrub and thornbush. The trees are mostly deciduous, and as the dry season advances they rapidly lose their leaves and pass into a state of rest till the approach of the rains, but a noteworthy feature is that they burst into leaf before the first rains occur, though the country is still in a most parched state after months of the dry season. Many of the flowers also seem to anticipate the rains in the same way, and spring starts apparently under the influence of increasing heat, but without the assistance of the expected rains. The

chief economic product of the forests so far, has been rubber from the natural vine, *Landolphia*, which is found over wide areas.

One feature of the vegetation which impresses itself on the traveller, much to his hindrance, is the rank growth of grass in many parts, commonly over 6 feet in height, and often much taller. This has a geographical bearing also, for after the advance of the dry season, usually about September, extensive fires commence, which during the next two months extend throughout the greater part of the territory, save where the densest and moistest forest belts occur. In rocky regions, the effect of these annual fires must prove an important factor in cracking and splitting the rocks. The detonation can often be heard during the course of a fire, and fresh fractures have been noted after the fire has passed by. The bare surface which is left behind is thus exposed to the full force of the torrential rains, and on steep slopes must suffer accordingly.

The country is on the whole fertile, but the white settlement is at present restricted to a narrow belt immediately adjoining the railway line from Beira, *viâ* Maçequeçe (Massi Kessi), into Rhodesia, and also to a much less extent, it is found along the hot but fertile lower Zambezi valley. Outside these relatively small regions there are vast tracts of country sparsely occupied by natives, and where the only method of communication is by kaffir paths, which in some places have been widened, and cleared sufficiently to allow of the passing of the Portuguese machilla or hammock.

2. The geographical features fall into certain well-defined divisions, which will be considered separately under their respective headings. They are as follows :—

(*a*) The Frontier zone.
(*b*) The 1000 to 2000 feet shelf.
(*c*) The Sunklands.
  (1) The Zambezi basin.
  (2) The Sabi basin.
  (3) The coastal lowlands.
  (4) The Urema belt.
(*d*) The Sheringoma plateau.

(*a*) *The Frontier Zone.*—The region here considered stretches over a north and south direction for over 300 miles. It follows approximately the eastern edge of the great Matabeleland plateau of Southern Rhodesia, several blocks of which extend easterly for short distances into the Portuguese territory. These are the Nyowamba and Boandwa mountains of the Barue, Venga and Vumba of Manica, the Shimanimani mountains and the Spungabera highlands of Moribane and Mossurise respectively.

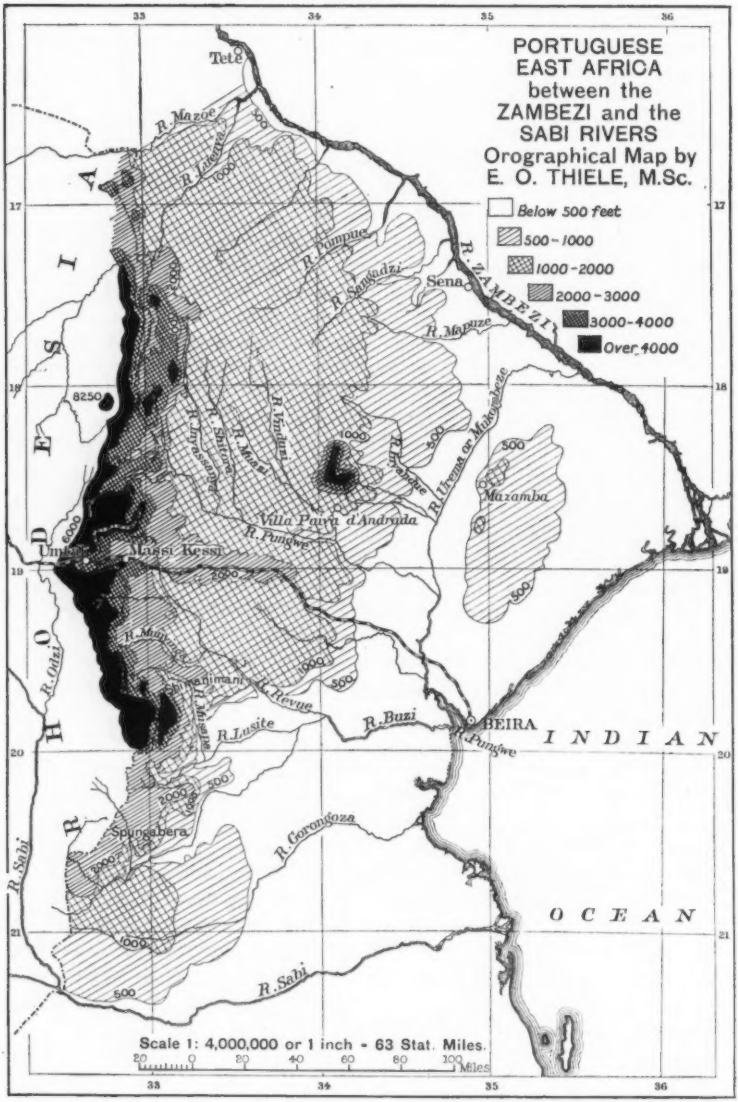
This is one of the most interesting parts of the country, for the tectonic features find striking expression in fault scarps and dislocated drainage lines. It is not the present watershed, though the highest points of the Matabeleland plateau are on this zone, rising to over 6000 feet, and one point near the source of the Pungwe is as much as 8000 feet. The major

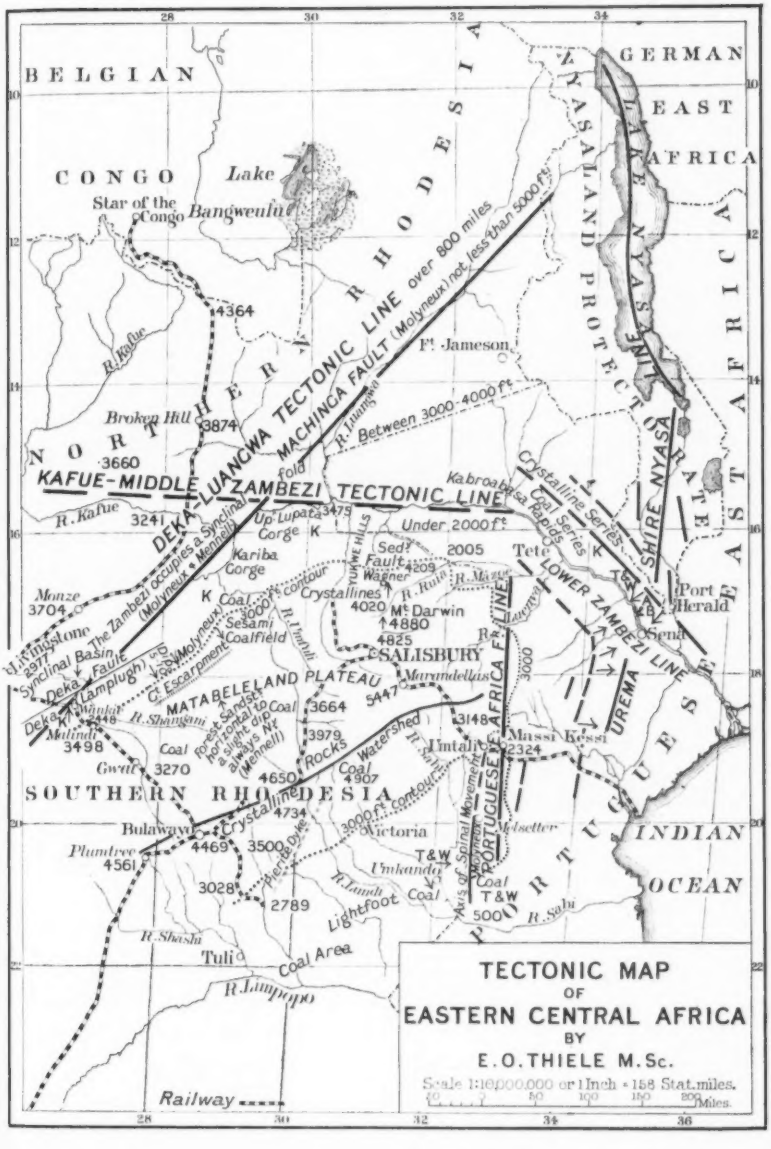
fracture runs almost true north, approximating to the 33rd meridian, and is well defined over a distance of about 200 miles, ranging from about 17° S. to 20° S. It would appear to be interrupted both in the north and the south by transverse fractures connected with the sunklands of the Zambezi and the Sabi. Minor parallel north and south fracture lines are also well developed, both to the east and west of the main line, but their north and south extension is more limited. The country drops suddenly to the east from altitudes of about 5000 feet to an extensive shelf only about 2000 feet above sea-level at the base of the scarp, and sloping away gently in an easterly direction to about 1000 feet.

In the middle portion a number of streams from Rhodesia cross the zone transversely through notches and passes, changing from wide open valleys of gentle grade on the high veldt to rapid rocky descents and falls till they reach the lower shelf, where their course is more gradual again. Some of the larger streams have cut deep gorges well back into Rhodesia—particularly the Lusite and the Pungwe. Several important streams follow the direction of the fracture line for considerable distances—notably in the northern and southern regions. In the north the course of the Gairedsi, an important tributary of the Luenya, coincides with the direction of the fracture line for about 70 miles. While in the south the Harom, a tributary of the Lusite, flows through a profound gorge along a north-and-south fault line bounding the western side of the Shimanimani block. The course of the Sabi-Odzi valley in Rhodesia is bounded on the east for at least 80 miles by a marked fault scarp, which is to the west of the main line. Many, if not all, the passes and river notches in the frontier zone are along transverse fracture or fault lines.

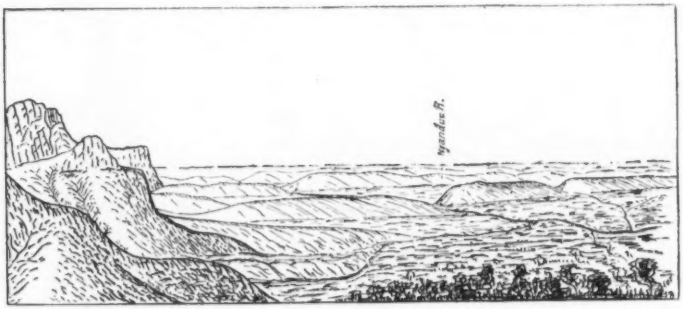
The Lusite crosses the frontier to the south of the Shimanimani block, where a well-defined fault or series of faults occurs, near the boundary of two distinct geological formations—a non-foliated series, consisting chiefly of sandstones to the south, and highly sheared quartzites to the north. The Musapa river crosses the same quartzites to the north along a fracture line. The Upper Munyinga notch occurs along the contact of a sedimentary series with the foliated granite, of the ancient crystalline series. Some of the other valleys have not been sufficiently explored in this part of their courses to give definite evidence on this point.

While considering the frontier zone, the several blocks of the high plateau of Rhodesia, which extend easterly beyond the main tectonic line for distances of 10 or 12 miles, call for some special remarks. We have not had an opportunity of examining the Nyowamba and Boandwa mountains of the Barue, but in Manica, two imposing mountain masses, Venga, 5550 feet, and Vumba, 4950 feet, respectively, rise steeply to nearly 3000 feet above the surrounding country. They both rise abruptly on all sides but the western, where they are joined by a ridge of slightly lower altitude to the main plateau. A striking depression, 6 to 8 miles wide, lies between these two masses. It contains the headwaters of the Revue and several

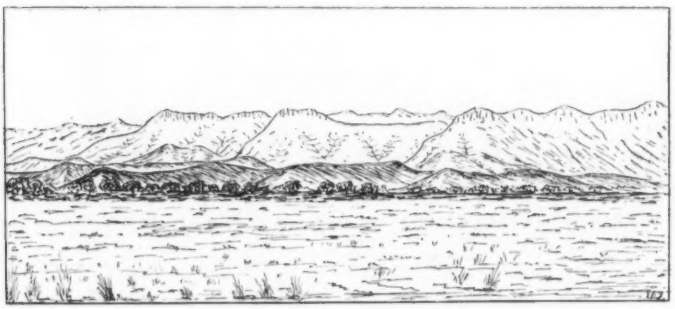

PORTUGUESE
EAST AFRICA
between the
ZAMBEZI and the
SABI RIVERS
Orographical Map by
E. O. THIELE, M.Sc.
Below 500 feet
500 - 1000
1000 - 2000
2000 - 3000
3000 - 4000
Over 4000
Tete
R. Mazoe
R. Luenya
R. Pungue
R. Sanguadzi
Sena
R. ZAMBEZI
R. Mupuze
R. Urema or Mukojarze
Mazamba
8250
R. Inyacandue
R. Shirira
R. Mudzi
R. Mudzi
R. Pungwe
Villa Paiva d'Andrada
Umtali
Massi Kessi
R. Odzi
R. Mutsikiri
R. Revue
R. Lusite
R. Buzi
BEIRA
R. Pungwe
INDIAN
OCEAN
R. Sabi
Spungabera
R. Corongoza
R. Sabi
Scale 1: 4,000,000 or 1 inch - 63 Stat. Miles.
20 0 20 40 60 80 100 Miles


BELGIAN
CONGO
Lake
Bangweulu
Star of the Congo
NORTHERN RHODESIA
GERMAN EAST AFRICA
NYASALAND PROTECTORATE
LAKE NYASA
SHIRE NYASA VALLEY
PORTUGUESE EAST AFRICA
INDIAN OCEAN
SOUTHERN RHODESIA
DEKA-LUANGWA TECTONIC LINE over 800 miles
MACHINGA FAULT (Molyneux) not less than 5000 ft.
KAFUE-MIDDLE ZAMBEZI TECTONIC LINE
LOWER ZAMBEZI LINE
UREMA
Ft. Jameson
Broken Hill
3874
4364
3660
R. Kafue
3241
Between 3000-4000 ft.
Kabroabasa Rapids
Crystalline Series
Under 2000 ft.
Sed?
2005
Tete
Port Herald
Kariba Gorge
Fault
4209
Wagner
Monze
3704
Crystallines
4020
Mt. Darwin
4880
4825
SALISBURY
Marandellas
MATABELELAND PLATEAU
5447
3664
3148
3979
Massi Kessi
2324
Umtali
Gwelo
3270
4650
4907
Rocks
Watershed
Bulawayo
4469
4734
3500
Victoria
Melsetter
Plumtree
4561
3028
2789
Umkandan
Coal
T&W
500
R. Sabi
R. Shashi
Tuli
Coal Area
R. Limpopo
Railway
TECTONIC MAP
OF
EASTERN CENTRAL AFRICA
BY
E. O. THIELE M.Sc.
Scale 1:10,000,000 or 1 Inch = 158 Stat. miles.
Miles.

of its tributaries. The depression, however, terminates on the west in blunt ends, caused by steep slopes, which rise to the Rhodesian plateau. The Beira-Mashonaland railway follows the southern side of this basin along the Munene valley, climbing up to a continuation of the same valley at a high level at Umtali, the ascent being over 1000 feet in a few miles. The rocks of the basin consist mainly of a fractured zone of softer schists; while the mountain masses are granitic, but difference in rock texture



NORTHERN FACE OF GORONGOZA MOUNTAINS AND RIDGES DUE TO PORPHYRY DYKES CROSSED BY THE NYANDUE RIVER, LOOKING WEST-NORTH-WEST.

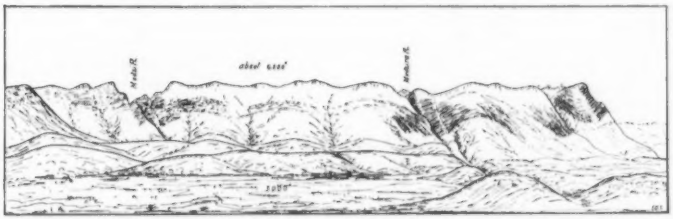


SOUTH-EAST FACE OF SHIMANIMANI MOUNTAINS AND LOWER RIDGES DUE TO FAULTING, FROM LUSITE LOWLANDS, LOOKING NORTH-WEST.

affected by erosion alone does not appear to be sufficient to account for the basin. The schists pass into Rhodesia, and the abrupt step at the head of the Revue valley traverses them. Vumba has an abrupt face to the east and south, where the rocks at the lower level are also granitic; so that it would appear that differential movement has also been a factor.

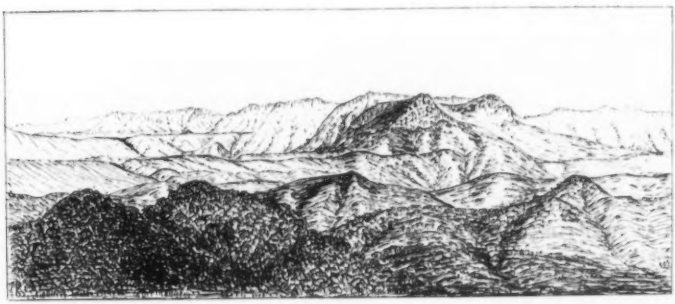
The next important block is that of the Shimanimani mountains, about 50 miles to the south of Vumba. Here the evidence of block faulting is clear, both geologically and physiographically. The mountains form a

rugged massif nearly rectangular shape, rising to over 6000 feet. It is about 20 miles long from north to south, and between 5 and 6 miles wide. It is bounded on all sides by fault scarps, which rise abruptly from 2000 to 3000 feet above the surrounding country. The rocks of the massif are mainly ancient sheared quartzites of the Swaziland system. Much younger sedimentary series are faulted against them on the west, and partly on the south. Foliated granite lies to the north and gniessic rocks mainly to the



EASTERN SCARP OF SHIMANIMANI MOUNTAINS, FOLDED AND FRACTURED QUARTZITES WITH VALLEYS ERODING ALONG FRACTURED LINES. MABATI PLATEAU IN THE FOREGROUND, LOOKING WEST.

(*From Photos and Sketches.*)



SHIMANIMANI MASSIF AND MABATI SHELF FROM SHIRUMA HILLS, LOOKING SOUTH-WEST.

(*From Photos.*)

east. The Harom river (20, Leverson) flows south along part of the western face, through a profound gorge. Several parallel strike valleys, the Mafumosi, the Merere, and the Little Musapa flow southwards for short distances, in high-level valleys in the massif. All drop over imposing falls before reaching the lower country. The first two have eaten precipitous and practically impassable gorges for some distance back to the present site of the falls, but the Little Musapa drops over the edge of the fault scarp. Two important streams descend over the eastern scarp, along old fracture lines—the Mudzi and Mudzira. A small but

interesting shelf, known as the Mabati plateau, adjoins the eastern edge of the Shimanimani massif.

It is overlooked on the west by the precipitous scarp of the Shimanimani mountains, rising fully 2000 feet above it. It has a steep drop to the north to the Musapa valley, and another to the south, both of which are fault lines. Along its eastern side is the deep, comparatively straight gorge of the Musapa, nearly 2000 feet deep, which probably follows a fracture line. The surface of the plateau lies at a general altitude of about 3000 feet. It is a pleasing, open, grassy area with shallow valleys of mature type in contrast to the deep gorges which are cutting back into it on the north and the south. It represents a small dislocated block of an ancient peneplain, so placed that rejuvenated streams are attacking it on three sides. It is difficult of access, but when it is reached it forms a delightful camping-ground, and convenient base for the exploration and study of the eastern portion of the Shimanimani mountains, whose precipitous scarp here reveals some interesting structures and important transverse fracture lines. The struggle for supremacy of the streams descending over its rim is well shown by a marked case of river capture, resulting in the present head of the Imkatuku having been diverted from its original course northwards to join the southern drainage.

The Spungabera Highlands.—This area is traversed by the frontier to the south of the Shimanimani massif. It forms part of the south Melsetter plateau of Southern Rhodesia, which extends across the frontier into Portuguese East Africa, and, geographically, it should be considered as a whole. The frontier line has here no relation to the surface features. The region is a very fertile one, possessing a good climate and rainfall, but its present inaccessible position and lack of adequate communication with the main railway line have retarded the development which it deserves. Geologically it is quite distinct from the rugged mountainous region of Shimanimani, consisting mainly of a much younger sedimentary series of somewhat uncertain age, associated with extensive intrusion of doleritic and other igneous rocks, to which the area largely owes its fertile soil.

Its surface may be described in general as a somewhat broken plateau, deeply dissected by relatively narrow steep-sided valleys from 1000 to 1500 feet deep. The highest portions of the region rise to well over 3000 feet, and most of it is over 2500 feet. It is bounded on the west, overlooking the sunkland of the Sabi and lower Odzi valley, by a well-defined fault scarp, 1500 to 2000 feet high. The northern boundary is not clearly marked, the country gradually rising to the main part of the Matabeleland plateau. On the east it abuts in part the western scarp of the higher Shimanimani massif, and in the Spungabera region it extends more easterly towards the Statonga range, ending against crystalline rocks. On the south it overlooks the great sunkland of the Sabi, dropping by a well-defined step of nearly 1000 feet, this line again marking a geological

SHIMANIMANI PASS, 4500 FEET, UPPER MUSAPA RIVER, LOOKING EAST.
QUARTZITE ROCKS.

UPPER MAFUMOSI VALLEY, 3000 FEET DEEP, AND FALLS, SOUTH-EASTERN
PORTION OF SHIMANIMANI MOUNTAINS.

LUPATA GORGE, ZAMBEZI RIVER, THROUGH VOLCANIC ROCKS, LOOKING EAST-SOUTH-EAST.

ZAMBEZI RIVER FROM TAMBARA, BELOW LUPATA GORGE, LOOKING SOUTH-EAST.

boundary. Thence southwards, the frontier traverses a great sunkland across the Sabi river to the Limpopo, a distance of about 150 miles.

(*b*) *The* 1000 *feet to* 2000 *feet Shelf*.—This area covers a wide extent of country amounting to nearly 20,000 square miles. It is about 100 miles wide, and is bounded on the west by the well-marked frontier scarp and plateau blocks just described. On the north it is bounded roughly by the sedimentary rocks of the Zambezi basin, and its southernmost extension ends along the south-west to north-east fault line of the Morungwezi-Buzi valley, but a branch of the coastal lowlands breaks across it a little to the north along the Lusite valley. The eastern edge is on the whole well defined by a sudden drop to the lowlands of 800 to 500 feet, but in northern Gorongoza and in the Sena district the change is less abrupt. It however follows closely the geological boundary between the ancient crystalline rocks, of which it is composed throughout its entire area, and the sedimentary series of the Zambezi basin: it is noteworthy, also, that the line coincides closely with a narrow zone of basaltic hills and ridges for a distance of more than 100 miles.

The general features of the area show clearly that the whole region is a huge dislocated block of a vast peneplain, part of which is now at a much higher level on the Matabeleland plateau. Evidence of the ancient dislocated valleys was described when dealing with the frontier zone. As the edge of the shelf is approached towards the lowlands, the rejuvenation of the streams becomes more marked; practically all descend to the plains through deep rocky gorges over numerous rock bars, rapids, and small falls. The rock bars persist right to the edge of the plain as a rule. The entrenched valleys are naturally less marked as the western side of the shelf is approached, but practically throughout the whole area the struggle to adjust a new grade is very active, most of the rivers flowing over very rocky channels with only occasional quiet pools. Most of the area is well watered by numerous permanent swift streams, save in the northern portion of the Barue, where they are intermittent, but nevertheless active during the rains.

The two most important rivers are the Pungwe and the Revue, both of which flow across the grain of the country in a south-easterly direction. The major fracture lines in the territory are north and south, and along the frontier zone there are also transverse fractures of varying length, in general between east and north-east in direction. The strike of the foliation planes of the crystalline rocks shows great local variation, but its prevailing direction lies between north and north-east. The general direction of the main-drainage, therefore, shows no relation to the above features, and would appear to be a consequence of the slope seawards of the eastern portion of the Matabeleland plateau. The tributary valleys as a rule also cross the grain in all directions, though, occasionally, local influence of structure is shown. The Lusite valley towards the south of the region is an important stream, but hardly belongs to the shelf, for it

enters the country from Rhodesia, south of the Shimanimani massif near the apex of a wedge of the lowlands, caused by faulting, bringing a tongue of the sunklands close to the frontier. After traversing a short but rocky canyon-course in the frontier zone, it emerges on to the plains at a point less than 50 miles from the frontier. Several of its important tributaries, however, belong to the region under discussion. The most interesting of these is the Musapa river which has a remarkable Z-shaped course. Its history has been markedly influenced by some of the important fractures and dislocations which have affected so many of the features of the country. It rises in Rhodesia at an altitude of over 5000 feet, and follows a more or less south-easterly course as an open high-level valley, coinciding in part with the western fault line of the Shimanimani block for a short distance. It then turns easterly through a narrow rocky gap, near the northern end of the Shimanimani mountains and next follows a rapid descent of several thousand feet through a wild and rocky cleft to the base of the mountains continuing easterly over a rocky channel, but at a less steep grade, entrenched in the shelf along one of the transverse fracture lines along the northern face of the Shimanimani block.

Its next change is a sudden turn to the south, to the east of the Mabati shelf. Its course here is a rocky gorge 1500 to 2000 feet deep along probably one of the minor north-and-south fracture lines, till it suddenly emerges on to the sunkland of the Lusite trough. Thence south-easterly till it joins the Lusite, it flows over wide sandy plains less than 500 feet above sea-level. Double capture influenced by earth-movement appears to have given it the present course.

The remaining chief feature of the shelf zone is the existence of isolated blocks, ridges, and inselberge. Some of the smaller of these features can easily be explained by differential erosion on rocks of varying texture and durability; but in the case of some of the larger blocks this explanation alone seems inadequate.

By far the largest and most striking of these isolated masses is that of the Gorongoza mountains. They lie near the eastern edge of the shelf to the north of the Pungwe river, forming a huge block rising steeply on all sides to nearly 6000 feet above sea-level and over 4000 feet above the surrounding region. Its shape is roughly that of a triangle with its apex truncated, the base being to the south. The greatest length is from north to south, amounting to about 20 miles, while along the southern base it measures about 15 miles. Its slopes and heights form a very rugged and precipitous piece of scenery. Its altitude is sufficient to ensure a copious rainfall, which has induced the growth of dense forest on its southern and south-eastern slopes and valleys, and also feeds numerous fine permanent streams, which descend by extremely rough courses often over picturesque waterfalls. Exploration is therefore difficult and arduous in this region. The geological features are important when considering the origin of this mountain mass. It is entirely composed

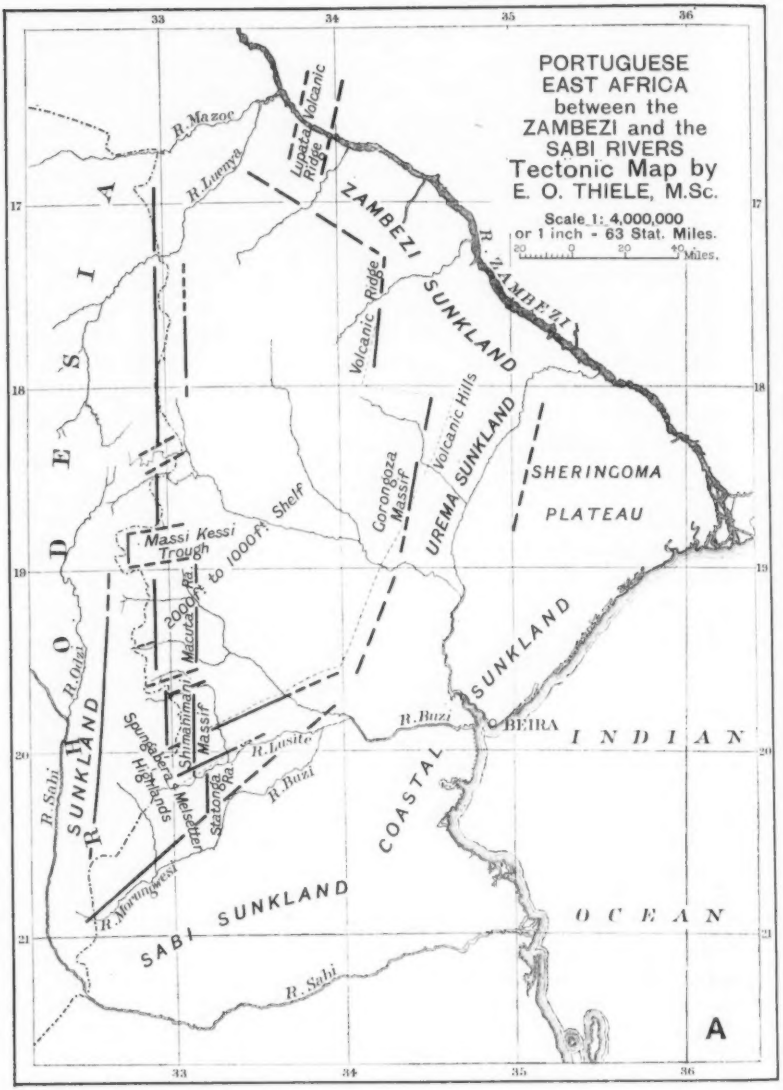
of syenite * and allied hornblendic rocks, while the surrounding country consists of ancient gneisses, the foliation planes of which lie at low angles of dip throughout this region. Though a complete traverse round the mountain was made, the actual contact of the syenite with the gneiss was only seen at one place. This was at the north-western corner, and the exposure was very limited, giving no evidence concerning faulting. Nevertheless, we feel that erosion alone is inadequate to explain the development of this huge elevated block. It seems necessary, therefore, to assume that block faulting has been an important factor here. The continuation of this line to the north appears to be a shatter zone with numerous fractures filled with porphyritic and basic dykes.

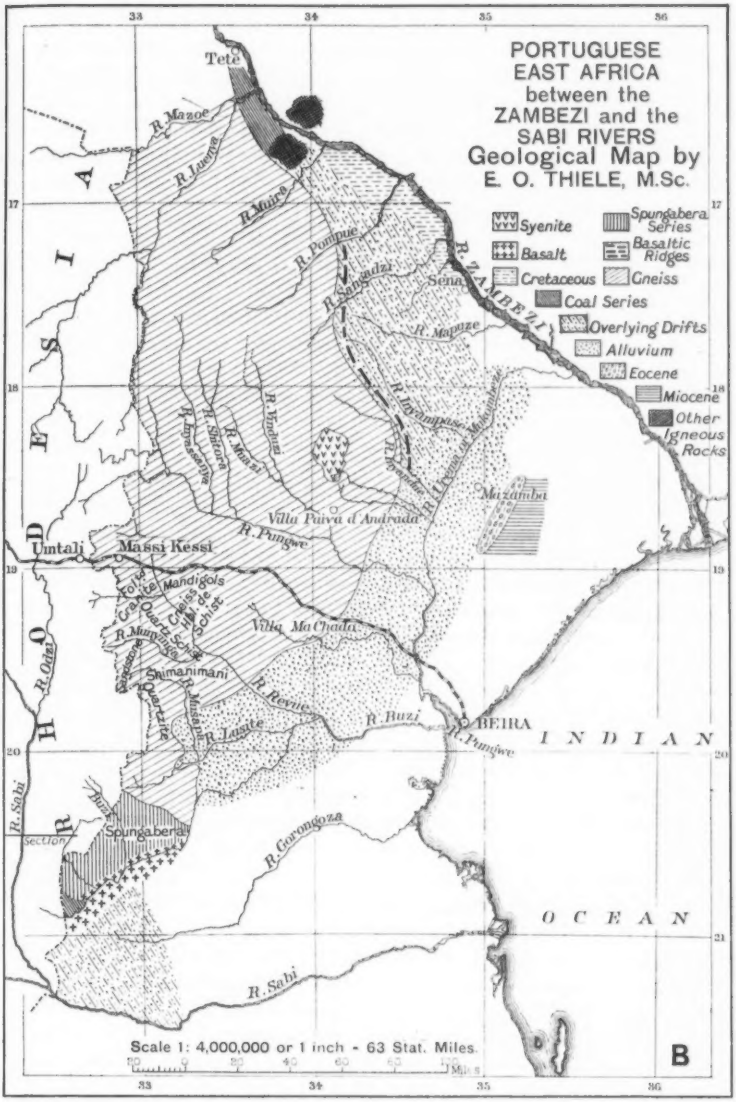
Another region much nearer the frontier calls for some attention. It consists of a broken ridge of some prominence running roughly north and south for at least 30 miles, and distant from the frontier about 20 miles, in the district to the south-south-east of Maçequeçe (Massi Kessi). It is composed chiefly of quartz schist and gneiss, while the country to the west consists mainly of later foliated granite, above which it rises abruptly to a height of 1000 to 1500 feet. The Revue cuts diagonally across the northern end, and the Munyinga transversely across the central portion through a rocky gap. The southern end of the ridge, known as the Macuta range, terminates abruptly, suggesting faulting. The present features are shown in Maps A and B.

The simplest explanation of the above features is that differential movement has taken place along the line of the Macuta ridge, but at a rate sufficiently slow to allow the streams to maintain their corrasion, and thus avoid deflection. The grade of the Munyinga is still steep and rocky where it crosses the ridge.

The inselberg type of landscape, so common in most of the crystalline areas of Africa, has frequently been described and discussed by various writers dealing with African topography. These hills are clearly types of monadnocks, and are hard remnants which have escaped peneplanation. Though showing a great variety of shape and form, they are, in general, marked by bare-rounded and dome-shaped surfaces, often so steep as to be quite unscaleable. The study of the relations of the surrounding rocks is usually made difficult by the rock *débris* and vegetation round their base. These hills vary in size from mere swellings above the general surface to prominences of considerable size and height, rising occasionally to as much as 1000 feet above the surface of the peneplain. Great curved and cracked shells of rock frequently hang in unstable positions on the steep faces ready to slide off to the base. Their abrupt discontinuity with the surrounding peneplain is one of their most striking features. Sometimes

* Syenite is used here as a field term; the rocks have not been examined microscopically. It is only necessary to note that the rocks of the massif are of a non-foliated granitoid type intrusive into the surrounding gneisses.


PORTUGUESE
EAST AFRICA
between the
ZAMBEZI and the
SABI RIVERS
Tectonic Map by
E. O. THIELE, M.Sc.
Scale 1: 4,000,000
or 1 inch = 63 Stat. Miles.
20 0 20 40 Miles.
33
34
35
36
17
18
19
20
21
R. Mazoe
R. Luenya
Lupata Volcanic Ridge
ZAMBEZI SUNKLAND
R. ZAMBEZI
Volcanic Ridge
Volcanic Hills
Corongoza Massif
UREMA SUNKLAND
SHERINGOMA PLATEAU
Massi Kessi Trough
Shelf to 1000 Ft.
2000 Ft.
R. Macuta
R. Orio
R. Sabi
SUNKLAND
Shimaihimani Massif
Spungabera Highlands
Melsetter
Statonga Ra.
R. Lusite
R. Buzi
R. Morungwesi
SABI SUNKLAND
COASTAL SUNKLAND
BEIRA
INDIAN OCEAN
A


PORTUGUESE
EAST AFRICA
between the
ZAMBEZI and the
SABI RIVERS
Geological Map by
E. O. THIELE, M.Sc.
Syenite
Basalt
Cretaceous
Coal Series
Overlying Drifts
Alluvium
Eocene
Miocene
Other Igneous Rocks
Spungabera Series
Basaltic Ridges
Gneiss
Tete
R. Mazoe
R. Luenha
R. Muire
R. Pompue
R. Sangadzi
Sena
R. ZAMBEZI
R. Mapuze
R. Inyampuse
R. Inyamazi
R. Inyamisengue
R. Inyamaseve
R. Shiroro
R. Mudzi
R. Mudzue
R. Mudzidzi
R. Urema
Mazambi
Villa Paiva d'Andrada
R. Pungwe
Umtali
Massi Kessi
Mandigols
Kopje Granite
Quartz Schist
Chlorite Schist
Villa Ma Chada
R. Mussapa
Shimanimani
R. Revue
R. Buzi
BEIRA
R. Pungwe
INDIAN
OCEAN
R. Odzi
R. Sabi
R. Lusite
R. Mutasa
R. Garongoza
R. Sabi
Spungabera
Section
Scale 1: 4,000,000 or 1 inch = 63 Stat. Miles.
B

they appear to show an approach to irregular grouping or linear arrangement, but just as often their irregular distribution is quite as marked. They are sometimes elongated along the strike, but frequently the direction of the foliation planes has no apparent connection with their shape or arrangement. Messrs. Holmes and Wray (13), in a previous number of this journal, enter into an interesting discussion on the origin of this type of landscape in Mozambique. Their observations led them to suggest that "the inselberg mark the positions of phacolitic or batholitic intrusions of igneous rock below. It would seem that dome-like intrusions have been the primary cause in determining the sites occupied by the present inselberg, the contrast of surface relief brought about by weathering and erosion being the outward expression of internal structure."

If this observation can be proved to be general it offers a simple explanation for many of the features. We have examined a great many of these hills in the territory under description, but do not yet feel convinced that we can confirm the above observation. We are, in general, in accord with the support they give to the views of Dr. Bornhardt (4), in German East Africa, and Dr. J. D. Falconer (10), in Northern Nigeria, to the effect that during a prolonged period of weathering at a time when stream activity was at a minimum on account of the country having reached base level, the rocks became decomposed to a considerable but varying depth. Subsequent elevation produced a rejuvenation of the streams, which then swept away the loose rock, leaving the resistant parts which had escaped decomposition as isolated hills. In this way earth-movements have had an effect, but we have so far failed to recognize any relation in their distribution or occurrence to local block faulting. The most striking feature in the weathering of these hills is the very large scale on which exfoliation is developed, the large curved shells scaling off more or less concentrically quite independently of the foliation planes of the rock. It is generally accepted that the exfoliation type of weathering of crystalline rocks is a temperature effect, but its degree of development in the inselberg type of hills is so marked that one seems forced to expect some internal structure of which the exfoliation is the outward expression. More research is required, however, to settle this point.

(*c*) *The Sunklands.*—These lowland regions occupy more than half the area of territory. In contrast to the shelf region, which is composed almost entirely of ancient crystalline rocks, those of this area are, with the exception of a few volcanic hills, entirely sedimentary. Rock exposures are, as a rule, rare, the surface being covered largely with a considerable depth of sand, clay, and gravel.

Few parts of these regions rise much more than 500 feet above sea-level, while most of it lies at a very much lower altitude.

(1) *The Zambezi Basin.*—That part of the Zambezi here dealt with embraces chiefly the territory of the Companhia de Mozambique, and

specially refers therefore to the country south of the Zambezi along its course for a distance of about 300 miles from its mouth. On the south bank of the river no solid rock has been observed from the mouth as far as the Lupata gorge, a distance of over 200 miles. The nearest edge of the crystalline series to Sena lies more than 60 miles away to the south-west. This margin continues more or less north-westerly, nearly parallel with the river course, but tending to approach somewhat nearer the river towards Tête. In the opposite direction it turns more southerly, diverging from the course of the Zambezi. For more than 100 miles this line has been traced showing the edge of a sedimentary series, chiefly sandstones and grits dipping at low angles in a direction varying from north-east to south-east, and passing under later more or less unstratified deposits of sand and gravel towards the river.

That this is a tectonic line seems certain, for it is marked also along a distance of, at least, 100 miles by a series of volcanic hills and ridges.

The Lupata gorge is an instructive example of the effect of a hard rock band changing the type and scenic character of a river course. It consists of a belt of volcanic rocks about 8 to 10 miles broad, striking transversely across the river in a north-north-easterly direction, and through which the river has cut a relatively steep-walled channel 400 to 500 feet deep. Above the gorge the river occupies a wide bed up to a mile in width with numerous sandbanks and islands, and on either side there are alluvial flats and low sandstone hills of the Karoo formation. On reaching the Lupata belt it suddenly contracts into a channel not more than several hundred yards wide, issuing again after a course of about 10 miles, and immediately spreading out over a width of several miles, divided into innumerable ever-shifting channels among reedy banks and islands. Following the river downward from here for more than 100 miles, that is below its junction with the Shire, the contrast between the scenery on either side of the river is very marked. On the north side a considerable amount of relief and variety of outline is shown at a relatively short distance from the river-bank. Between the Lupata and Sinjal, hills rising to well over 1000 feet show a slight dip and scarp contour due to the erosion of slightly inclined sedimentary beds of the Karoo series. Below Sinjal, and continuing for some miles, rocks of the crystalline series approach to within a few miles of the river, forming prominent and pointed hills. Opposite Sena, in the neighbourhood of Muterara, some lower hills approach close to the river, composed chiefly of red grits with a marked dip towards the river. Basaltic rock is also associated with the series, outcropping at the water's edge. On approaching the junction of the Shire river, the abrupt massif of the Morambala mountains can be seen running northerly as a wall-like mass to the east of the Shire river, rising steeply to more than 4000 feet, and terminating abruptly at the southern end overlooking the vast extent of the plains of the lower Zambezi. This

prominent and elevated mass would appear to be the southern extension of the great block which in Nyasaland rises in the Mlange mountains to 8000 feet, and lies to the east of an important tectonic line extending from Lake Nyasa along the Shire valley.

Turning now to the southern bank of the Zambezi, the contrast is striking. A low monotonous and even line meets the eye, broken only in the neighbourhood of Sena by several small conical peaks of volcanic origin. It is the surface of a low plateau of soft rocks rising to barely 200 feet above the river, and consisting of very soft pebbly sandstones and clays overlaid by beds of gravel, occasionally passing into extensive beds of coarse, waterworn boulders. These deposits continue back from the river for a distance of roughly 60 miles, close to the edge of the crystalline series where harder sandstones dip underneath them associated with the line of volcanic rocks previously referred to. The greater altitude of the country on the north side of the river, the abrupt termination of the elevated granitic and metamorphic masses, together with marked faulting and tilting of the sedimentary series, point clearly to a decided fracture line running from north-west to south-east, more or less parallel with the course of the river and intersecting the Shire fracture line. Concerning the age of the fracture little can be said save that it is post-Karoo. Possibly it was connected with the volcanic disturbance which marked the close of that period, the movement continuing with interruption into late Tertiary times. One of the latest movements would appear to have been a slight general uplift, resulting in the shallow dissection of the soft rocks of the Sena basin, by the Sangadzi, the Pompue, and other similar streams, and the development also of alluvial terraces of great fertility along the Zambezi river.

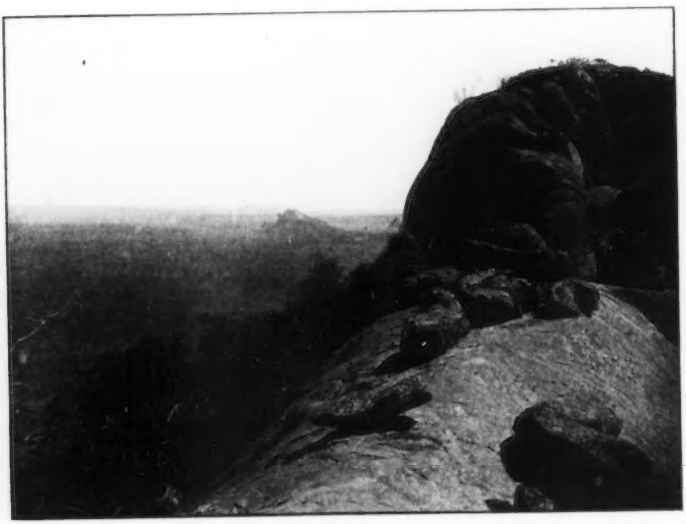
(2) *The Sabi Basin.*—This area is part of a great lowland in the southern portion of the region extending probably as far as the Limpopo river. Like the Zambezi sunkland, its surface is largely covered with loose sandy deposits, and in places beds of coarse, waterworn boulders similar to those of the Sena basin are found. The northern margin is marked by a distinct surface feature which is also a geological boundary. It is formed by the southern edge of the Spungabera highlands, and further east by the termination of the crystalline series. The marked north-and-south ridge of the Statonga range here comes to an abrupt termination. The break in the continuity of the surface is here distinct, all the evidence pointing clearly to an important fracture line running in a north-easterly direction, the course of which is followed by the Morungwezi and the Buzi after the latter issue from the hill region.

The lowlands extend uninterruptedly into Rhodesia, where an important branch runs north, forming a wide flat-bottomed depression along the Sabi valley, bounded on the east by a strikingly straight scarp, the western edge of the Spungabera-Melsetter plateau. As in the Sena region, a shallow dissection appears to indicate a slight uplift. A few miles from

FRONTIER MOUNTAINS, ABOUT 6000 FEET, LOOKING WEST FROM NEAR SHAIA, ABOUT 2000 FEET.

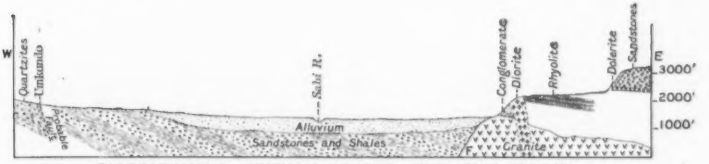
GORGE OF LUSITE RIVER IN QUARTZ-SCHIST AT LITTLE MUSAPA JUNCTION, LOOKING EAST-SOUTH-EAST.

ENTRENCHED VALLEY OF UPPER MERERE RIVER, SHIMANIMANI MASSIF, ALTITUDE ABOUT 6000 FEET, LOOKING NORTH-WEST TO HIGHEST POINT OVER 7000 FEET.



PART OF THE 1000-2000 FEET SHELF WITH INSELBERG FROM SANGA HILL, NORTH FROM GONDOLA, LOOKING NORTH-WEST-NORTH.

the frontier on the Rhodesian side the course of the Sabi is crossed by a hard band of rocks, causing imposing falls which have been referred to by Leverson (20). We have not had an opportunity of examining this interesting feature.



DIAGRAMMATIC SECTION ACROSS THE SABI VALLEY

Horizontal Scale 6 miles = 1 inch
Vertical Scale 6000 feet = 1 inch

(3) *The Coastal Belt.*—This region covers a vast extent of country but little elevated above sea-level. It is for the most part tree covered, with considerable tracts of open grassy plains interspersed. The drainage is ill defined, and during the rains vast areas become flooded with water, a fine breeding-ground for myriads of mosquitoes, resulting in a very unhealthy season for this zone. We have not had an opportunity of examining the coast, so cannot say whether there is any evidence of the interesting raised beaches described by Holmes and Wray (13) to the north of the Zambezi delta.

(4) *The Urema Plains.*—This area forms an interesting belt between the Zambezi and the Pungwe, extending over a distance of about 130 miles, and in general covering a width of 30 to 40 miles. It is continuous with the coastal plains on the south, and the general surface features are quite similar, but it is convenient to consider it separately, for, unlike the coastal plains, it is bounded along the greater part of its eastern side by the well-defined plateau scarp of the Sheringoma tableland of post-Miocene age, rising in its highest point to an altitude of about 1000 feet. It therefore takes the form of a wide shallow trough, its western side being the edge of the shelf of ancient rocks previously described. It is significant that this line of depression is a direct southerly continuation of the Shire fracture line. Its shallow features may be accounted for by the greater depression of the whole of the country south of the Zambezi fault line.

(*d*) *The Sheringoma Plateau.*—This forms an interesting elevated block lying between Beira and the lower Zambezi. It is an isolated area rising above the surrounding lowlands to an altitude of about 1000 feet. It is composed of marine sediments ranging from Upper Cretaceous to Middle Tertiary, its top consisting for the most part of a Miocene foraminiferal limestone. Only a small part of this area has been examined by us, but it gives interesting information concerning the post-Miocene age of the movement of this block, and the evidence of the youthful character of the streams cutting into its western scarp favours a recent date for the movement.

2. The Relation of the Main Fracture Lines to those of the Adjoining Areas, especially Rhodesia.—Our observations in the region described have led us to consider and compare those of other workers in adjoining areas to the west and north, with the result that a similar relationship between tectonic movements and existing surface features is so striking that we find it well worth reviewing some of the broad aspects. It becomes increasingly clear that, powerful and important as ordinary denuding agencies have been in these vast areas of ancient land surface, the great controlling factor concerning the existence and distribution of the vast plateaux, basins, and river systems must be attributed to far-reaching tectonic forces.

The observations of Lamplugh (17), Molyneux (26), Mennell (23), Maufe (24), and others in Rhodesia; Lapierre (18), and our own in Zambezi; Andrews and Bailey in Nyasaland (1); Holmes and Wray (13) in Mozambique, taken in conjunction with those we have made south of the Zambezi, show convincingly how closely many of the broad physiographical features are connected with powerful and extensive fault and fracture lines.

Taking the great Matabeleland plateau of southern Rhodesia, which consists in the main of a huge block of unyielding crystalline rocks, we find that it is bounded on almost all sides by striking scarps, which are either proved fault lines or are parallel to them.

The western and north-western side of the plateau is bounded by part of one of the great tectonic lines of the continent, which may well be described as the Deka-Luangwa line.

It has been traced practically continuously from near the Victoria falls in a north-easterly direction for more than 800 miles towards the northern end of Lake Nyasa. We owe much of our knowledge of the Deka end to Lamplugh (17), while Molyneux's (26) valuable contributions embrace the greater part of it extending into northern Rhodesia along the Luangwa.

It is intersected in its middle portion by a transverse line, about which our knowledge is still very imperfect. This we have called the Kafue-Middle Zambezi line. Molyneux has referred to an east-south-east line in the neighbourhood of the Zambezi-Luangwa junction, but it would appear that the line has a much greater extension affecting the middle course of the Zambezi nearly as far as Tete, and accounting also for the northern scarp of the Matabeleland plateau. Little is known of this region, but the observations of Wagner (34), who made a rapid traverse in this part in the neighbourhood of Mount Darwin and the Mazoe river, are of great interest, pointing to the probable extension of the fault-line in this region. It is important to note that these lines appear to be directions of pre-Karoo movement also.

Our own observations have enabled us to study a great part of the eastern edge of the southern Rhodesian plateau, and this we have named

the Melsetter-Massi Kessi line. It also affords good evidence of being an ancient tectonic zone.

The lowland regions in the south-eastern portion of Rhodesia towards the Sabi and Limpopo basins are very imperfectly known, but there would appear to be a repetition in this area, though on a less marked scale, of many of the features of the Zambezi basin.

We have examined all the geological information we could find bearing on the physical features of Rhodesia, which, though scanty and fragmentary, is most instructive, for it all points to the view that the great Matabeleland plateau, covering an area of more than 1500 square miles, is the result of far-reaching tectonic forces acting upon a great mass of crystalline rocks tending to arch and uplift it in a broad dome-shaped manner. The unyielding nature of these ancient rocks, however, to folding, together with a greater tendency than sedimentary rocks to fracture, has led to the formation of a series of fracture lines and dislocations. The major zones bound the plateau, and are best developed along its eastern edge and in the Zambesi basin.

The intersection of many of the minor fractures has developed a series of blocks which, during the successive crustal adjustments, have suffered differential movement, some undergoing uplift as horsts, others remaining more or less stationary or subsiding. Our observations, based mainly on a study of the rejuvenation of streams, are in accord with those of Molyneux (26), that movement is probably still in progress.

The deep Mozambique channel, an important tectonic line, lies to the east of the area under discussion, and it is, perhaps, significant that it is approximately parallel with the great Deka-Luangwa line.

It will be seen from the above review that the main directions of fracture or movement run north and north-east respectively. A glance at the map of the east coast of Africa, including the coast of Madagascar, shows a remarkable alternation of north and north-east trends—so marked is it that it seems to suggest a definite relation to the important tectonic lines that have such a controlling influence on many of the broader features of the great plateau blocks of the continent.

Taking a general review of our present knowledge of the main tectonic lines in Rhodesia, Nyasaland, and Portuguese East Africa, they appear to fall into four groups, and two of which, the north and the north-east, are the most important.

North.—Nyasa-Shire line (1); Melsetter-Massi Kessi; Sabi-Odzi; Lebombo (25); Rababwi and others of Mozambique (13); east coast of Madagascar (31); many of the basaltic and other intrusions coincide with this direction.

North-east.—Deka-Luangwa line (17 and 26); Mozambique channel (31); Buzi-Morungwezi; Urema. The prevailing strike would appear to coincide most closely with this line.

East to East-south-east.—Kafue-Middle Zambezi.

South-east.—Lower Zambezi.

It is important to note that the position of a number of hot springs occurring in the region under description, the temperature of which ranges from about 100° F. to about 160° F., is on or near well-marked fracture lines. One found to the west-north-west of Shikore Mission Station lies on the Sabi-Odzi fault line. Unfortunately we failed to see this on account of misleading information given to us in the locality.

The Shaiva hot spring lies just to the south of the Morungwezi-Buzi line, and further to the north-east on the same line there is a much more powerful spring situated at the southern termination of the Statonga range. The flow of water here is considerable, but we had no opportunity of gauging the amount.

The Shimuriro spring in the south of Gorongoza near the Pungwe river lies close to the eastern edge of the shelf. This is the hottest one, the highest temperature noted being 160° F. From all these springs there is a notable evolution of gas, which is probably for the most part carbon dioxide. The waters are only slightly saline, but the results of analyses are not yet available.

Summary of Conclusions.

The special features to be emphasized in connection with general erosion are—

(*a*) A long dry season, during which the country becomes very parched.

(*b*) Annual fires, fed by a rank growth of grass, extend over a great part of the country, laying bare the surface, and often cracking the rocks considerably.

(*c*) Temperature effects are important on exposed rocks on account of the wide range between day and night temperatures.

(*d*) The rainfall is abundant and of a torrential character, most of it falling during about two months of the year.

(*e*) The altitude of much of the country is sufficient to render the streams of the hill region extremely active.

(*f*) From a consideration of the above features, taken in conjunction with the character of the stream sands, it would appear that mechanical erosion is very active.

The surface features are divided into four divisions—

1. A mountainous frontier zone, the eastern edge of the Matabeleland plateau, which rises in general to over 5000 feet in altitude. Though modified to a considerable extent by erosion, the north and south direction of the scarp is wonderfully straight over a distance of more than 200 miles. The abrupt rise of about 300 feet above the country to the east, taken in conjunction with the geological evidence, indicates that it is an important tectonic zone of fracture and movement.

2. The features of the 1000–2000 feet shelf are those of an ancient peneplain. Its characters could not have been developed in its present position. The steep scarp to the west, the sudden drop to the plains in the east, and the rejuvenated river system, all point to recent dislocation. Its surface features are similar to those of the Matabeleland plateau, with which it would appear to have once been continuous.

The inselberg type of landscape is well developed, and is accounted for mainly by differential decay and erosion during long-continued peneplanation. The exfoliation which is so marked a feature of the weathering of crystalline rocks appears to be mainly a temperature effect. No satisfactory evidence seems to be yet forthcoming to indicate whether or not internal structure has any controlling influence.

3. The sunklands.

Though these are composed of softer sedimentary rocks in contrast to the hard crystalline rocks of the plateau, erosion has not been the only factor in their development. They occupy basins some of which were initiated in pre-Karoo times. The synclinal structure of the beds, together with the evidence of later faulting, indicates subsequent movements, due to successive adjustments along old tectonic lines. These features appear to prevail throughout the Zambezi and Limpopo-Sabi basins. Tectonic movements, therefore, seem to have controlled to a great extent the general position and main direction of these basins.

4. The Sheringom plateau forms an isolated tableland rising above the coastal lowlands. Its marine sediments afford interesting evidence of the post-Miocene age of this uplift.

The directions of movement and fracture fall into four main groups.

(*a*) North and south.

(*b*) North-east.

(*c*) East to east-south-east.

(*d*) South-east.

The north and south line is the most important, coinciding with the main tectonic zone of Eastern Africa—volcanic features and other intrusions are associated with this direction. This and the north-east line represent ancient tectonic lines of pre-Karoo movements also.

The persistent alternation of northerly and north-easterly trends along the east coast of Africa and Madagascar, together with the parallelism of the margins of the Cretaceous and Tertiary rocks with this direction, appears to have some relation to the two major tectonic lines of the continent. The Matabeleland plateau, with the surrounding lowlands and basins, is the result of far-reaching tectonic forces, which have developed well-defined fracture-lines. Ordinary erosion effects have been considerable, but have been controlled and guided largely by the tectonic factors. Important movements appear to have started at the close of the Karoo period, and they have continued with interruptions until recent

times. Though the north and south direction is the dominant one, it is probable that the movements along some of the other lines were more or less simultaneous, especially where block faulting took place. The influence of structural features on the direction of some of the river-courses is most marked in the frontier region. Portion of the course of the Buzi is influenced by a north-east fault-line; but in the case of the Pungwe and the Revue no relation to structure has been noted. The convergence of all the important streams, however, toward a point near Beira is an interesting feature.

In conclusion, we would like to express our indebtedness to the various commandants and other officials in the territory of the Campanhia de Mozambique, who have offered us hospitality and assistance during our explorations in the country, and particularly we would like to mention Mr. Austin King, Director of Mines, Massi Kessi, Mr. G. d'Almeida and Mr. W. Donkin, both of the Mines Department, Mr. Lanne, Commandant of Mossurise, and Mr. Bivar, Commandant of Gorongoza. To the last-named also we wish to acknowledge a very useful sketch-map of his district, the result of much care and work, which proved a very useful guide and basis for our explorations.

We wish also to thank the Directors of the Companhia de Mozambique for permission to publish the results of our observations.

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Sir Thomas Holdich (Vice-President): Having recently had a business connection with the Mozambique Company, I have naturally listened to Mr. Thiele's lecture with very great interest. I may say his description of the geological features of the country is entirely new to me, but the beautiful series of photographs with which he has illustrated the topography of the country has given me a much clearer idea of Portuguese East Africa than I ever had before. For some years I struggled in vain to persuade the Portuguese Government to have a geographical survey made which might prove useful, both commercially and geologically, but I never succeeded; so I may congratulate Mr. Thiele on having, at any rate, developed a thoroughly sound descriptive analysis of the Mozambique hinterland, which certainly seemed at one time to be quite beyond reach. By the way, I particularly call attention to the useful nature of those diagrams and sections which he drew to illustrate geographical features. To my mind they are more useful even than photographs. If I may venture on one small criticism it would be we should like to have had a reference here and there in the general map to the particular portion of the country to which he was referring at the time of speaking. There are present gentlemen personally well acquainted with the country who no doubt will be able to tell us something more about it.

Mr. G. W. Lamplugh: The paper is a clear account of the possible structure of the country, and brings together helpfully the facts that have been gathered. My own impression is that it will be found eventually that erosion has been more potent than faulting in the production of the features described. In rapidly traversing a country, it is natural at first to suppose that the big straight features are uplifts by faults. If Britain were an uninhabited island and only known from a few traverses, I am sure that some big faults would be drawn where we now know there are no faults. In fact, that is what did really happen to some extent in the first geological surveys of England; many faults were put in that have proved to be non-existent, while, on the other hand, mining has proved the presence of many faults of which there is no evidence at all on the surface. From what I saw in the Zambezi country, I believe it will be the same there. The big Deka fault, where I first saw it up on the plateau, showed very little evidence at the surface in the way of features. But in descending the Deka valley, the river began to pick out the lithological structure and found a hard barrier along the fault; and then it was that the fault became a conspicuous feature, but it was not developed until the plateau broke away into the Zambezi basin. This fault is evidently older than the plateau, and where the fault-feature exists it is evidently secondary; and though in one sense structural, it is not tectonic. If the high plateau is as old as it appears to be, it is difficult to imagine that any of the faults that may have occurred at its edges can have remained as sharp features for such a prolonged period. My impression generally is that in the future, when the country is better known, we shall probably appeal more to the torrential erosion on the steep marginal gradients for the actual production of the features, although the old faults may have had much to do in guiding the erosion along lines.

Mr. John Parkinson: I should like to join Mr. Lamplugh in expressing my indebtedness to Mr. Thiele and to Mr. Wilson for the paper they have given us.

It has been of a special interest to me, for I have lately spent a year in British East Africa in that part of the Rift valley which borders on German territory, and in the photographs which we have seen this afternoon I recognized many familiar features, especially the broad flat valleys with their vertical sides. The Authors have mentioned one point of importance to which I should like to refer, and that is the "bulging" of the central portion of Southern Rhodesia, implying, I conclude, lateral pressure. Near Lake Natron, almost on the borders of English and German territory, Uhlig mentions the superposition of quartzite-mica-schists on recent lavas, and infers that overthrusting may have been a factor in the production of the Rift valley. Evidences of pressure were found by myself in the same district, and I would ask whether the authors have noticed any indications of such an agency or of overthrusting amongst the later rocks. A few specimens from the northern province of Portuguese East Africa are in my hands, collected some years ago by my friend Mr. L. H. L. Huddart about south latitude 12° and 39° east longitude. In a letter he talks of precipices dropping at least 1000 feet and mentions the very constant north and south strike of the schists and crystalline limestones, from which it seems possible that a structure similar to that south of the Zambezi may be found to distinguish also the northern part of this territory.

Mr. Arthur Holmes: I think all of us, and particularly those of us who are geologically interested in this part of Africa, must have listened to Mr. Thiele with the greatest of pleasure. I had the good fortune about three years ago to be occupied as geologist on an expedition to the Portuguese district of Mozambique. It may be of interest to make a few remarks in reference to the structure of this part of East Africa, for in many respects it bears a close resemblance to the structure of the Protectorate south of the Zambezi, as described by Mr. Thiele.

In Mozambique the contrast between plateau and mountain is more marked than in the southern area. Denudation appears to have progressed further, for the outlines of the plateau are less rugged, and the contours of the inselbergs are, if possible, even more precipitous. To some extent these features may be due to the prevalence of granite and gneiss throughout the country.

Much attention has been given to north to south, and north-east to south-west structural lines. In Mozambique the latter are represented by the prevailing direction of foliation of the gneisses, and by the lines of granite intrusions, which in some cases appear to be responsible for the presence of inselberg peaks. The north to south lines are generally represented by more recent faults and fractures. From Fernão Velloso bay to Mokambo bay, a distance of 25 miles north and south of Mozambique island, there appears to be a fault, or a series of small faults, between the Cretaceous sediments on the east and the Archæan complex on the west. This line is parallel to many of the major faults described by Mr. Thiele; and other important tectonic features which follow the same direction include the long eastern coast-line of Madagascar, many of the inselberg blocks of Mozambique, and parts of the Nyasa depression.

It is claimed that the Rhodesian plateau represents an upward-lifted portion of the earth's crust, and the question arises whether Mozambique affords any further evidence for a similar uplift. I think that it does, and particularly from a petrological point of view, as I shall now try to show. Along the coast of Mozambique lies a zone of sedimentary formations, partly of Tertiary, but largely of Cretaceous age. Crossing the country westwards, as soon as the coastal belt has been left behind, one traverses Archæan rocks without a break

for hundreds of miles. Schists are not very abundant in Mozambique, but those few which do occur, together with bands of crystalline limestone, and gneisses of sedimentary origin, are, as far as I know, confined to within about 50 miles of the coast. Further west the gneisses become coarser in structure than is usual nearer the coast, and granite intrusions are found in steadily increasing abundance. West of Ribawe, about 200 miles from the coast, basic rocks, eclogites, and anorthosites, are found. It has been suggested that garnet may be taken as an index of high pressure, when it occurs in igneous rocks. The presence of this mineral, and the basicity of the associated rocks, seem therefore to imply a more deep-seated source in the earth's crust than that represented by granites. Thus, the rocks from east to west are successively of a more and more deep-seated character.

This generalization is by no means applicable to small areas, but it appears to express the outstanding structure of the country. Since, then, the garnet-bearing igneous rocks west of Ribawe outcrop in the plateau at a level of 2000 feet, and since the schists, etc., occur almost entirely below a level of 500 feet, it seems clear that the deep-seated rocks occur in the most elevated positions, and that the central part of Mozambique has therefore been upthrust relatively to the coastal belt. This would, indeed, be naturally expected, for this part of the earth's crust appears to have, structurally, a wave-like form. Lake Nyasa represents a depression; Mozambique, an elevation; Mozambique channel, a depression; Madagascar, an elevation; and finally the Indian ocean, the greatest of all the depressions.

It may be interesting to observe that where volcanic rocks occur they are generally near the borders of the depressions, that they always represent fissure eruptions, and that they usually include alkaline varieties. In my opinion the Mozambique area supports Mr. Thiele's view that certain parts of the African plateau have been relatively uplifted. It would be interesting to learn whether the observations of geologists working in other parts of the continent lead to similar conclusions.

Mr. F. P. MENNELL: I should like to make some remarks as one of the few people whose observations link up with those of the authors. I have geologized along the Sabi valley somewhere about 20 miles from the Portuguese territory they have described, and there are one or two things in my observations which support their ideas. Mr. Lamplugh has alluded to the fact that it has been the tendency in countries like Rhodesia and the surrounding territories to attribute too much to faulting, and I agree with him regarding the importance of erosion, but, on the other hand, I might say that I have noticed a very big fault along the Sabi river which has been put on record on a map which the authors have evidently not seen. It is one which you can actually see, and it follows exactly the course of the Sabi and then of the Odzi river a considerable distance above its junction with the Sabi. It thus runs almost north and south, and seems to follow a practically straight line, while it is not away back from the river: the course of the river has closely followed it. There is another point to which I may allude, and that is the upward bulging which the authors attribute to the Matabeleland plateau. I may say that this is not the Matabele plateau at all, but the plateau which includes the greater part of Mashonaland; it ought to be called the Rhodesian plateau. An upward bulging of this plateau has certainly taken place in the way they suppose, but nevertheless sedimentary rocks are much more common on the high country than they seem to realize; indeed, a few years ago I wrote a paper, which was actually called the "Sedimentary Rocks of the Rhodesian Plateau." With regard to the question of the age of the

sandstones of the Sabi valley, I think they are undoubtedly of Waterberg age. I travelled over them for some 60 or 70 miles, and I obtained very good evidence that they correspond in their order of succession to the Transvaal rocks, and have the same lithological characters. At their base I found a limestone which does not seem to be known in the Transvaal at all, and I do not know quite how it corresponds to anything in the Transvaal, but there is no doubt, I think, of the Waterberg age of the other beds. There are sandstones on top and shales below, and they are thrown down in the flats on the western side of the Sabi river by the great fault to which I have alluded. The throw of the fault may be called *plus* 700 feet and probably a great deal more: it depends on how far the top of the granite is below the surface of the ground. I should like to congratulate the authors on the very valuable contribution they have made to our knowledge of the region, which is a very interesting one.

Mr. R. Bullen Newton: I am desirous of placing before the meeting one or two remarks on the fossils Mr. Thiele has collected in this territory, because, from the stratigraphical point of view, they are of great importance. This collection has been presented to the British Museum, and although no properly detailed work has yet been attempted upon the specimens themselves, I am able to recognize the fact that they belong to three very definite geological horizons. The oldest are to be referred to Upper Cretaceous times on account of the presence of the characteristic oyster, known as *Alectryonia ungulata*. This oyster is found in similarly aged rocks of Madagascar and India, an occurrence which helps to support the theory that a land connection existed between Africa and India during the Cretaceous epoch. Next in order is a series of fossils containing a well-marked nautiloid-shell resembling *Hercoglossa diderrichi* * with deeply angular or sinuated septa, and therefore indicative of a Lower Eocene age. The youngest specimens are to be referred to the Miocene period, being represented by a limestone composed entirely of minute Foraminifera belonging to the genus *Amphistegina* (size = 2 or 3 millimetres in diameter), and which is closely allied if not the same species as that occurring in the Austrian "Leithakalk" (= *Amphistegina hauerina*), which is recognized as part of the Tortonian stage of the Miocene deposits. This interesting organism has also been found in the Miocene limestones of Egypt, Madagascar, India, and the far Pacific regions, such as Formosa, New Hebrides, etc. The genus also lives in tropical seas. It was my privilege some eighteen years ago to announce for the first time the presence of Upper Cretaceous (*Journ. Conchology*, 1896, vol. 8, p. 136) and Eocene rocks (*Geological Magazine*, 1896, p. 487) in Portuguese East Africa, a result obtained from an examination of fossils collected by Mr. Draper from the Buzi river district and Sofala, about 100 miles south of the area whence Mr. Thiele obtained his material. The Cretaceous rocks on that occasion were identified by the same oyster (*Alectryonia ungulata*), whereas the Eocene were recognized by a limestone containing various species of *nummulites* and orbitoidal organisms. Mr. Thiele's specimens allow us to go a step further in our knowledge of the sedimentary rocks of that country as the *Amphistegina* limestone indicates that a Miocene sea once invaded that area. Mr. Thiele is to be congratulated in every way on the success of his expedition.

Mr. E. O. Thiele: I am pleased to find that the paper has called forth such an interesting discussion. At this late hour, however, there is hardly time to

* This species has been described and figured by M. E. Vincent from the Bas Congo region of Africa, and regarded as of Palæocene age (*Ann. Mus. Congo Belge Geol. Pal. Min.*, 1913, Ser. 3, vol. 1, pl. 6, p. 37).

do justice to the numerous points raised. I will endeavour to reply in a general way to the main questions, and hope the enforced omission of some of the minor points will be excused. Three of the speakers referred to the upward bulging suggested for the Rhodesian plateau. I unfortunately omitted to point out the nature of the evidence when describing one of the diagrams. It is mainly based on the consideration of the dip of the sedimentary strata flanking the margins of the plateau, taken in conjunction with the bearing of the general physiographical evidence. The information is somewhat fragmentary, but it all points towards the suggestion we have made. We were quite aware of the existence of the sandstones referred to by Mr. Mennell in the western portion of the Rhodesian plateau. He has pointed out that though the dip is at a low angle it is always northerly towards the Zambezi, all the evidence being in favour of that region consisting of a synclinal basin. The work of Molyneux also in this region and that of Wagner in the vicinity of the Mazoe river supports the synclinal view, as also do our own observations in the lower Zambezi basin. Further, the sedimentary rocks along the eastern flanks of the crystalline rocks have a dip seawards, and in the southern portion of the territory of the Company the dip of the Karoo rocks is southerly towards the Sabi river. Little is known about the sedimentary rocks in the south-eastern portion of Rhodesia, but the work of Lightfoot seems to indicate that the dip though somewhat variable is in the main between south and south-east. All this points to a general sagging down of the sedimentary basin flanking the margins of the plateau, and the physiographical evidence is in favour of the view that the plateau as a whole has been uplifted. Broad doming accompanied by fracture and dislocation appears to offer the best explanation of the features.

With regard to Mr. Lamplugh's objection to faulting and earth-movement overmastering erosional forces, he has raised a very debatable point. We admit that it is a very difficult matter to assign the proper share to erosion and tectonic forces respectively, for both have had a powerful influence. How much of the face of these imposing scarps is due to recent movement and how much to erosion? This is the vital question. After having considered it very carefully, we favour the view that in this region tectonic forces *have* dominated erosion.

The plateau margins throughout Africa south of the equator are characterized by striking shelves or step-like descents to sea-level. Natal is one of the regions where these features are well developed, and there also various observers have differed as to their origin. It has been held that faulting is the correct explanation, while Molengraaft believes that the uplift has been of the type of a broad monoclinal fold, and that the shelves have been cut out by the erosion of the consequent streams. The stratigraphical evidence in many places points to the type of uplift, but it seems difficult to explain the succession of steps together with the straightness and abruptness of the scarps over long distances, without invoking the aid of faulting also. It has been suggested that the shelves are due to marine erosion, and in some cases in South Africa marine sediments rest on them, but the 1000–2000 shelf under discussion is 100 miles wide—a very broad platform for marine erosion. There is here not the slightest evidence of marine sedimentation, and the features of the whole surface are those of a peneplain with a rejuvenated river system. It is difficult to explain such a wide area of mature erosion bounded on one side by an abrupt scarp of three to four thousand feet high and a steep drop on the other, without the aid of faulting. The scarp, though notched by erosion, is wonderfully straight; foot hills are either absent or insignificant along its base, and there are no gradually sloping spurs leading up to the scarp between the river basins. It is well known that faulting often brings a soft set

of rocks against hard ones, and that erosion subsequently cleans away the softer material forming a scarp. There is no evidence, however, that this applies in the case under discussion. Perhaps the best instance we can quote in favour of faulting is the southern face of the Shimanemani massif; here a scarp cuts across the quartzite mass and the foundered ridges of quartzite, a few hundred feet in height, and abruptly against the base of the scarp which rises steeply at least 4000 feet when the ridges continue along the top of the Massif.

It has been suggested that many of the scarp features are due to the laying bare of a pre-Karoo landscape by the stripping off the strata by erosion, and this must be carefully considered. Mr. Mennell has shown that in the maturely eroded central portion of the plateau this feature can be observed in various stages of development. The plateau margins do appear to approximate to direction of pre-Karoo movement, but it is clear that they are also lines of post-Karoo faulting, particularly along the Zambezi valley, and it is significant that these fault lines are parallel to the present scarps and usually not far from their base. We admit that erosion has modified the scarp and caused some recession from the fault, but our stand is that erosion has been dominated by tectonic forces in the cases being discussed. The age of the movement is difficult to decide. Some of it would appear to have been moderately recent, and the evidence of the Sheringoma plateau shows that there, at any rate, there has been an extensive post-Miocene uplift of at least 1000 feet.

Mr. Mennell's remarks concerning the Sabi valley are very interesting and most important. The fault line he has observed is long and straight and exactly parallel with the western scarp of the Melsetter-Spungatera highlands. That the fault is not exactly at the base of the scarp does not affect the question seriously, for we admit that erosion must have caused some recession. The fault lines represented in our diagram are more or less diagrammatic, and when we have indicated faulting by one straight line there is most probably a system of parallel faults.

Mr. Mennell's objection that the term "Matabeleland plateau" is not sufficiently comprehensive has a good deal to say for it, and we are quite willing to change it to "South Rhodesian plateau."

Mr. Holmes' remarks concerning the Mozambique territory north of the Zambezi emphasize many of the features we have observed, and bring out specially the marked parallelism of many of the surface features to the two dominant north and north-east tectonic lines.

In reply to Mr. Parkinson, we have not observed in this region any evidence of the recent overthrust features which he has referred to, in British and German East Africa.

In conclusion, I wish to thank all the speakers for their appreciative remarks concerning our observations.

Sir THOMAS HOLDICH; It seems to me that we have not only had an exceedingly interesting lecture, but a useful discussion besides. It only remains for me to ask you to thank Mr. Thiele, with whom I will associate Mr. Wilson, for the interest of this afternoon's lecture.

CARTOGRAPHIC NEEDS OF PHYSICAL GEOGRAPHY.*

By ALAN G. OGILVIE.

THE increasing demand for sound regional descriptions induces the geographer to take stock of the cartographical documents of all kinds which exist to aid him in his task of writing these descriptions, and to aid people in general in reading them. As is well known, geography draws its material from the results of researches in many branches of science. The present paper is an attempt to discover to what extent these results—in so far as they affect physical geography—are expressed in maps; and to suggest ways in which the various sciences might farther assist geography by the more frequent employment of cartography.

TOPOGRAPHIC MAPS.

In the description of the surface relief of a region the aid of the topographic map is required. The representation of relief on topographic maps has recently been discussed by Captain Lyons † at a meeting of the Society and there is no need to enumerate here the various methods adopted on existing maps. There are, however, several points which it seems worth while to emphasize concerning the value of these maps to the student and teacher of physical geography. It must of course be recognized that the main object of official survey departments is and must be the publication of maps which will meet the requirements of the greatest number of interests—military, landed, travelling, etc.—in the country. The result of this is that features of special interest to physical geography are frequently obscured, or are indistinctly shown in order that they may not obscure other features.

ORDNANCE SURVEY MAPS.

This state of affairs exists in many countries. Let us consider the case of the Ordnance Survey maps of the British Isles, and the way in which they may be put to better use for the purpose in view.

We have in this country probably a greater number of different editions of official maps than is to be found in any other. Each of those editions has some special merit which makes it the best edition for some particular purpose. In nearly every case, however, editions are withdrawn from sale when superseded. I would urge strongly the advisability of making all old editions available for geographical work, and I believe that, so far as the maps were actually published, this could be done with little, if any, expense to the Government. Two illustrations must suffice to show the need for this reform.

For the study of physiography the wideness of the 100-foot contour interval of our maps renders the hachuring of the greatest importance.

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* Royal Geographical Society, July 2, 1914.

† *Geographical Journal*, vol. **43**, p. 233.

The subsidiary and frequently indistinct nature of this in the recent lithographed maps, however, compares most unfavourably with the clear and beautiful hachures of the old engraved map, at any rate in the majority of the sheets. For this reason the engraved map, preferably with hachures in brown, should be kept accessible to all.

Again, in regard to layered maps on the half-inch scale the Ordnance Survey have been met with the difficulty of finding a colour scale suitable to all sheets, and have now arrived at a scheme based on that of the International Map. If a sheet showing moderate relief be selected from the new edition—*e.g.* in S. England—and compared with the map recently withdrawn, which had a different colour scale and in addition a stippled hill-shading, it will be found that the latter gives a far clearer conspectus of the relief than the current edition. That the old edition was unsatisfactory for countries of greater altitude and relief does not seem to me a sufficient reason for withdrawing, at any rate, the sheets covering areas of moderate altitude and relief where it is for many purposes the best map which has appeared on the scale. If the features which are due to man have had to be altered on the new map, the old map might before being sold receive a stamp to indicate that those features are not up to date.

The teaching of physiography in this country is greatly hampered by the high price of the official maps. The most which has been done up till now to make these maps more accessible, is the provision that a large number of copies of any sheet may be sold to schools at a reduced rate. It is probably impossible at present to reduce the general cost of Ordnance maps to a price approximating, for instance, that of the excellent topographic sheets of the United States Geological Survey. And yet it would seem to be a relatively easy matter to get over the difficulty by procuring the publication of selected sheets in the form of an atlas of typical landforms. It is a duty of the Geographical Societies of this country to procure the publication of such an atlas, and to ensure that it be accompanied by a satisfactory descriptive text. It is greatly to our shame that at present we have to turn for such documents to Germany and to the United States. While the materials now existing are quite sufficient for the publication of an atlas on the 1-inch scale, there are many types of landform which it is most advisable to include in such an atlas, but which cannot be shown on this scale. I suggest that the sheets of the "6-inch" scale of the Ordnance Survey on which the land features occur should have contour lines inserted sufficiently closely to illustrate the special features. In some cases an interval as small as 5 feet would be necessary, though in most cases 20 or 25 feet would be sufficient. The Ordnance Survey should be asked to do this contouring, as it would probably cause little trouble in districts where survey parties were in the vicinity. Wherever such work cannot be done officially the Geographical Societies should have it done by qualified persons.

In the case of coastal regions the co-operation of the Admiralty would be necessary, as it is most desirable to show the sea bottom by the same

method as that adopted for the land. Some idea of the scheme suggested may be gained from Fig. 1. It shows two overlapping wave-built forelands formed during a period of interrupted uplift. The contours in this case are approximate.

There is one other means by which the Ordnance Survey might greatly assist the study and teaching of physical geography in the future. The obscuring of one element by another in the complete colour-printed map has been referred to. It would be a great boon if it were possible to obtain the prints from each colour separately or copies showing a combination of printings, but without that printing which obscures the features it is desired to emphasize. It would appear that the only difficulty in the way of this being made possible is the increase of maps to be kept in stock.

Landforms.

An essential part of physical geography is the description of landforms in the light of their genetic classification. Physiographers now agree that in order to describe landforms in this manner three things must be known, viz. structure, process, and stage.

The description of landforms, then, will be greatly aided by illustrations which will represent graphically what an author is trying to tell in words. Thus, block-diagrams, which show diagrammatically something of the surface relief and something of the structure, have been much employed in such descriptions in recent years. For some purposes it is desirable to show but one element in each illustration. Let us see to what extent the map may serve this purpose, and consider in turn whether it is possible to have a *structure* map, a *process* map, and a *stage* map.

Structure.

The structural features which influence the landforms are two, first the chemical and physical composition of the rocks—*e.g.* as in clay, limestone, or basalt; and secondly the posture of the rocks relative to the surface and to one another, *e.g.* horizontal, tilted, folded or faulted.

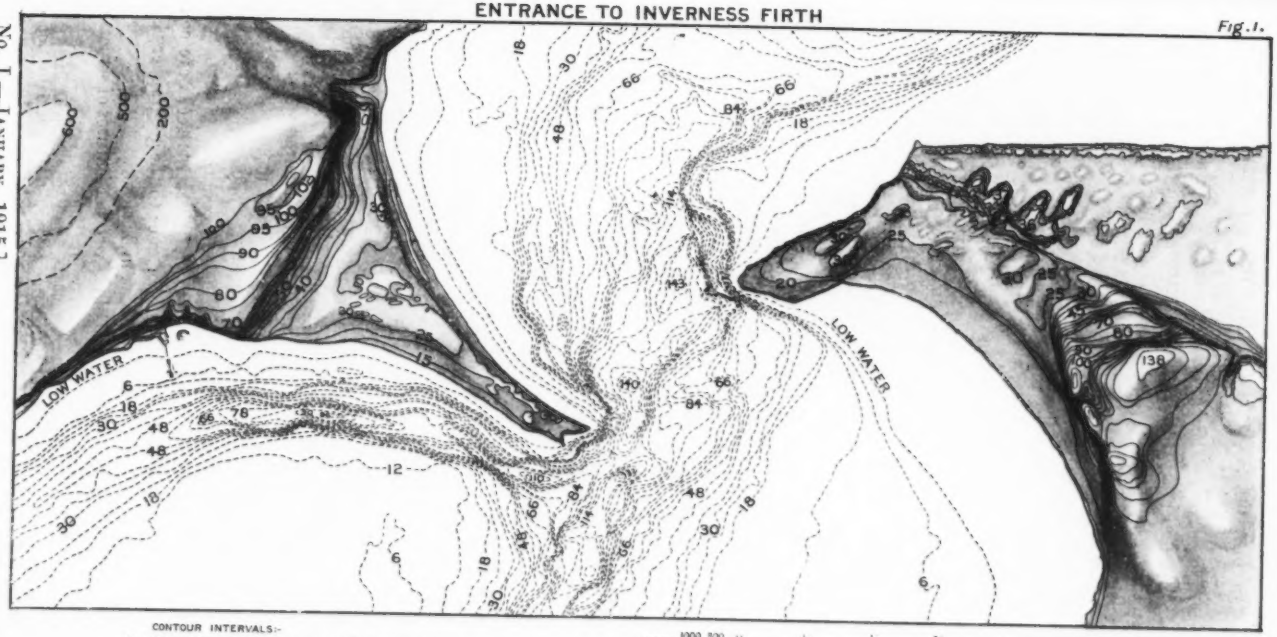
We naturally look for such facts upon geological maps. Do we find them there? and if so, are they in the most suitable form for use in explanatory description of landform? These are questions which we have to answer.

Geological maps are of two main kinds. The first, which is by far the less common, is a diagram showing tectonic lines—axes of anticlines and synclines, faults, directions of overthrusting, etc. Most of such data are of great importance in the discussion of landforms, they help to show the posture of rocks, and must therefore be included in the structure map.

The second type of geological map is much more familiar. It shows the distribution on the surface of the outcrop of rocks of different ages. By referring to the index, as a rule, the reader of such maps can discover no clue to the chemical and physical composition, *i.e.* the lithological

ENTRANCE TO INVERNESS FIRTH

Fig. 1.



CONTOUR INTERVALS:-
ON LAND, 5 FEET, STARTING FROM ORDNANCE DATUM.
ON SEA, 6 FEET, — LOW WATER LINE, ORDINARY SPRING TIDES.
Contours are approximate

FEET 1000 500 0 ¼ ½ ¾ 1 ONE STATUTE MILE
CABLES 0 5 10 ONE SEA MILE

character of the rocks.* The igneous rocks are an exception to this, and occasionally a sedimentary rock receives a name which is of direct use in this connection, *e.g.* Old Red Sandstone. But, generally speaking, the names convey no clue to the nature of the strata. They will be found to be classed as "Silurian" or "Ordovician" because rocks of similar age were first examined in the districts of certain Welsh tribes so named, or as 'Permian" because rock of the same age occupies extensive areas near *Perm* in Russia, or again as "Trias," so called from its *three* members—only two of which exist in Britain—or as "Tertiary," because the rock was formed in the *third* of the great geological epochs. No more need be said to show that these geological terms culled from so many sources have no geographical significance, since two rocks bearing the same name in different regions may be as different as black is from white. And yet the English student beginning geography is led, by the inaccessibility of lithological information, to assume for instance that a rock named "Silurian" since it is old must also be resistant; and he finds it difficult to believe in the existence of weak Silurian clay near St. Petersburg.

In order to discover what is the lithological nature of the rocks one must have a detailed geological knowledge as well as a geological map. This may reasonably be exacted from advanced students of geography *in their own country;* but for the help of beginners at home and of all foreign students we must have a short cut to this knowledge. In other words, we must have a lithological map. If we make one for our own country we are doing only what we should like people abroad to do for us. For who is there among us who, desiring to study the surface form—say of Italy—would not save himself the trouble of reading much Italian geology by simple reference to a lithological map?

Maps showing rock type might of course be made on any scale; but probably the most generally useful would be on small scales such as 10, 16, or 25 miles to one inch. Of course, as the scale gets smaller more generalization becomes necessary, and in many cases the determination of rock type becomes arbitrary. In spite of this, I believe the map would be of the greatest service to teachers and students of geography at home and abroad, as well as to foreign geologists.

The following are the chief elements of the map required:—

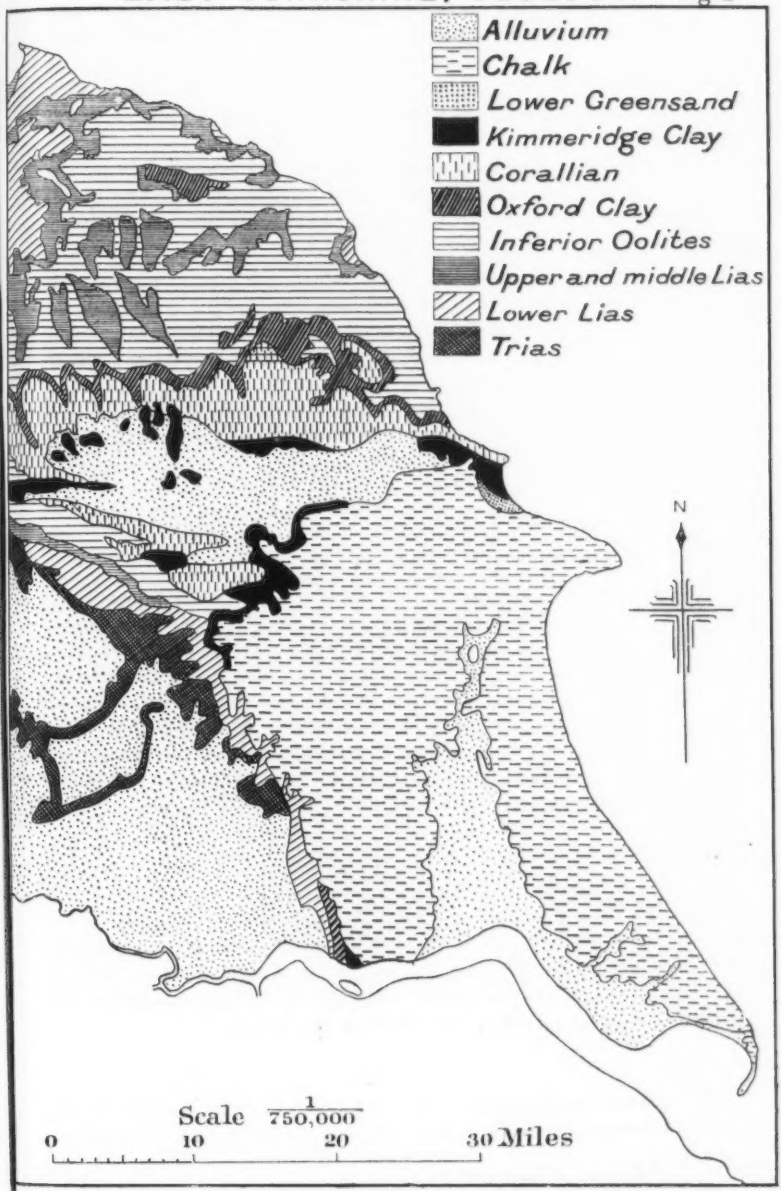
(1) The broadest classification of rock types would be essential, *e.g.* limestone, sandstone, clay, granite, schist, etc., and, where possible, smaller differences should be indicated, *e.g.* between oolite and chalk.

(2) It should be a "drift" map in districts where the rocks are concealed by drift; it is as a rule of greater importance to the geographer that the drift be shown rather than the rock which underlies it.

If the map were not too crowded it should have other features of structure

* This is, of course, true mainly in the case of the smaller-scaled maps—the ones which are most used for geographical purposes. In such maps generalization of rock-type is necessary.

EAST YORKSHIRE, GEOLOGY. *Fig 2*



added, and might then be termed a structure map. These features are chiefly (1) the main lines of faulting; and (2) the direction and angle of dip of strata.

A portion of the map of Yorkshire drawn on such lines is given in illustration of the above. It is to be regarded only as approximately accurate.

Before leaving the more geological aspect of the paper it may be well to refer to two closely allied subjects which involve investigations by the geologist, researches which would throw considerable light on the origin of our landforms, and of which the results—if they were sufficiently definite—might well be expressed on maps.

The first task we should set is a determination of the permeability of the various rocks, which might result in a map with rocks tinted according to a scale of porosity. The second task is more difficult to perform, viz. to determine the degree of resistance of various rocks. In this case it is often said that an orographical map of a country gives a fairly accurate conspectus of the relative resistance of rocks. But it will be seen that this is not the case, if we take into account the possibility of various districts representing different stages in the cycle of erosion, a condition which may be produced by the greater uplift of one district than another.*

Process.

The mapping of areas which are undergoing different processes of erosion or deposition would be profitable for certain purposes, and especially so in teaching. It is frequently the case that more than one geological process is at work on a region at one time, and in nearly every case existing landforms are to be traced to a number of these processes, which have acted in the past either simultaneously or successively. Thus it is difficult to determine whether a district should be shown as subject to river action, ice action, frost weathering, wind action, and so on. It will probably be best to select the process which seems to have had the greatest effect on the land, and since so much simplification is necessary the "process" map should take the form of the small-scale diagram of the continents or large portions of them. We have what practically answers this description in one of the Oxford Wall Maps, showing the distribution of "deposition and erosion" over the Earth.† Such facts might be expressed on somewhat larger scales than in this map, but between wall diagrams and maps on the scale of about 1 : 100,000 such mapping would be unprofitable. Its treatment on large-scale maps will be dealt with below.

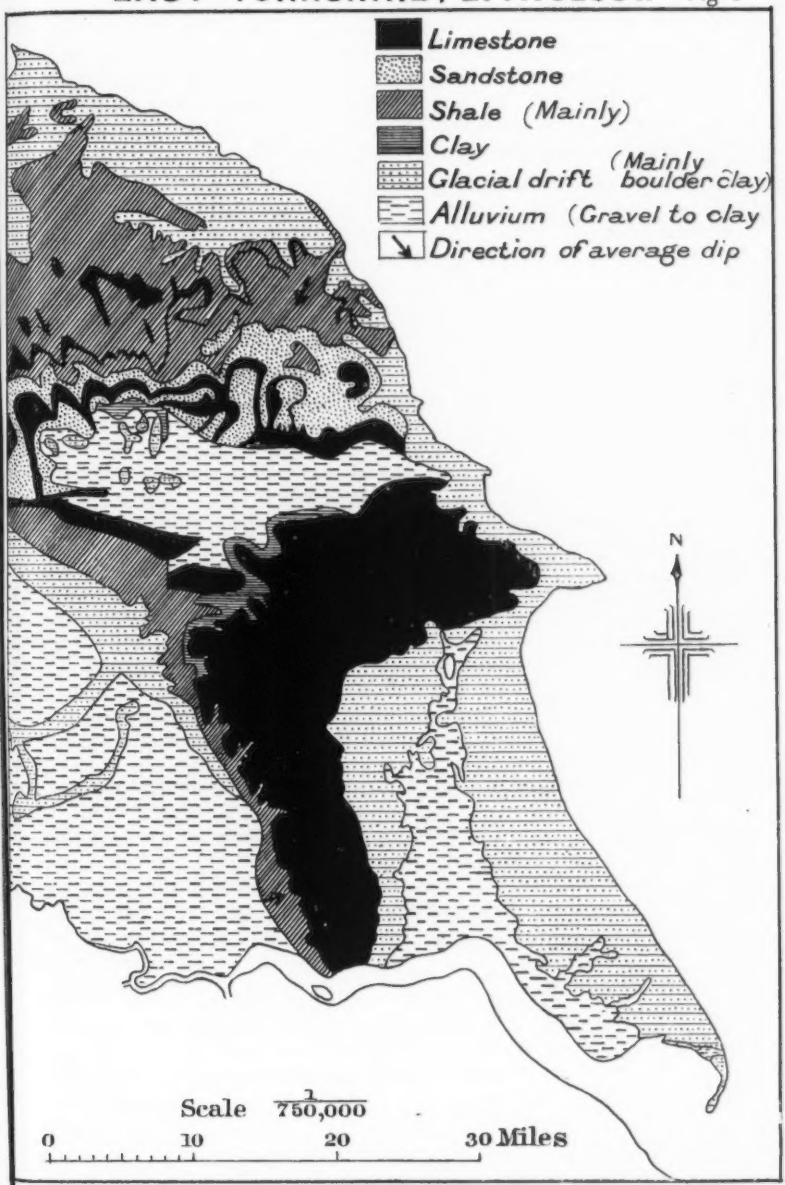
Stage.

We now come to the representation of the third element in physiography, namely the stage reached by a land surface in the cycle of its development,

* See note at the end of the paper.

† This map was based largely on the maps in Berghaus's Atlas.

EAST YORKSHIRE, LITHOLOGY. Fig 3



where certain processes are acting upon certain structures. Physiographers are not yet in complete agreement as to the exact features which shall define the various stages—young, mature, and old—in the case of lands affected by the various processes. Physiography and geography are greatly indebted to W. M. Davis for his clear definition and arrangement of this whole subject; and though his method still has its opponents, it seems likely that some classification such as that adopted by him in his recent work * will eventually be upheld. When a uniform system has been adopted and the lands examined in the light of it, it will be a simple matter to plot the areas on maps. But as in the case of "process" it will not be profitable to do so on all scales. Thus we might tint an ordinary atlas map of England so as to show the lowland of the Oxford clay as a peneplain and the oolitic upland as a maturely dissected plateau. It will, however, be more profitable to consider all the land together which has undergone the same process for the same length of time, and this larger area may be mapped as mature as a whole, though its resistant rock surfaces may be young and its weak rock surfaces old. As in the case of "process" then the maps of "stage" should mainly be small-scale diagrams.

Landform Maps.

While maps of the last two classes must probably be very limited in their uses, there would be general recognition of the value of some forms of maps showing the distribution of landform types, where structure, process and stage have been taken into account in examining the features. The writer would advocate the construction and use of two types of diagrammatic maps of landform. The one small-scaled, the other large-scaled.

(*a*) *Small Scale.*—To appreciate the value of the small-scaled map let us consider a concrete case.

Let us suppose, for example, that we wish to find out from the maps of Russia what are the main physiographical features of that land. A geological map shows us that rocks varying in age from the pre-Cambrian to Tertiary crop out in very irregular belts extending generally from north-east to south-west, with the oldest on the north-west and youngest on south-east. We have no lithological map. We must therefore go to geological books, some of them in Russian, to get a satisfactory account of the nature of these rocks of varying age.

If we now examine an orographical map of Russia we find that in spite of the great variety in the ages of the rocks, and presumably in their lithological character, the land is not far removed from being an immense plain. We are therefore probably justified in assuming that this is a peneplain. To obtain confirmation we may look at large-scale topographical maps such as the Russian map 1 : 126,000 or the Austrian map 1 : 200,000.

* 'Die Erklärende Beschreibung der Landformen.' 1912.

If we examine sheets which show any of the great southern rivers we shall probably find that these are flowing in valleys with entrenched meanders, and with the spurs more or less truncated and flood plains more or less developed according as the rivers are greater or smaller. It is now apparent that we are not dealing with a peneplain, but with a dissected and probably therefore uplifted peneplain. But if before leaving the topographical maps we glance at sheets showing the mouths of these same rivers, we find that arms of the sea enter the valleys, and that these estuaries are practically shut off from the open sea by sand bars. In other words, this *liman* coast of South Russia tells us of subsidence of the land—or, at any rate, of a raising of the base-level of erosion with regard to the land. Thus, by examining various maps we may arrive at a simple and explanatory description of physical features which, though slight, yet determine in large measure the routes and settlements in much of Russia in Europe—viz. *a peneplain somewhat uplifted, tilted, and dissected, with its southern edge slightly submerged.*

Now, this deductive process is undoubtedly educative, but I submit that it should not be necessary for every one to go through it in the case of all known lands of the Earth. Moreover, the conclusion reached may be wrong. When satisfactory information has been obtained as to the landforms of a region—not, of course, by the method just described, but on the ground—it ought to be recorded in a form which admits of easy reference. The most concise form is the map; and the physical atlas of the future ought, I believe, to give maps of this character for all lands of which the physiography has been described.*

(*b*) *Large Scale.*—The identification of landforms on large-scale maps can never be completely satisfactory even on the very best contoured and hachured maps. But when the true nature of the features and their origin have been investigated on the ground, the results of the work ought to be expressed on a map so that any one can recognize the landforms with the help of the map. Two sheets of a map of this kind have recently been published by A. Allix, to accompany a study on Alpine landforms.†

On these sheets the French 1 : 80,000 map is taken as the basis. This map, it will be remembered, shows the relief by black hachuring without contours. Over it are printed a number of conventional signs of different forms and colours to distinguish the special landforms which are described in the memoir. The colours are selected according to the process to which the feature is due, and the shape of the conventional sign bears a general

* Since the above was written, the first part of a new systematic atlas of Europe has appeared ('Methodischer Atlas zur Länderkunde von Europa,' by Dr. Max Friederichsen, pub. Hahn, Hannover and Leipzic, 1914). The first part happens to deal with Russia. On Plate I. a "morphological-tectonic" map is given. It is practically a tectonic map distinguishing mountains and plains dating from different geological periods. There is no map such as I have described.

† "La Morphologie Glaciaire en Vercors," in 'Recueil des Travaux de l'Institut de Géographie Alpine,' vol. 2, Pt. I., 1914.

relation to the landform to which attention is to be directed. Thus by signs of various shapes printed in *blue* we have certain features attributed to *solution* and identified as grikes, swallets, polyes, etc., or again, the signs in another colour direct our attention to drumlins, moraines, ice-worn troughs and thresholds, etc. In reading these maps it is advisable to have copies of the hachured map without overprinting, as the signs inevitably mask the relief to some extent. For this reason it might be well if the map or diagram bearing the conventional signs were issued as a separate print on transparent paper, which might be laid over the ordinary topographic map.

These two sheets, by their clearness and by the great help which they give in reading the description they illustrate, prove definitely that there is room for such large-scaled landform maps.

Hydrography.

Some of the most useful documents in the study of British regional geography are the Memoirs of the Geological Survey on Water Supply. More recently these have had included in them accounts and maps of the rainfall of the areas described by the pen of Dr. H. R. Mill, Director of the British Rainfall Organization. Except for the unfortunate fact that the areas dealt with are the extremely unnatural county divisions, these memoirs are, from the geographical standpoint, entirely satisfactory, so far as they go. They would, however, be greatly assisted by maps showing areas supplied by (*a*) wells, distinguishing those where the wells periodically dry up; (*b*) surface streams; and (*c*) stored rainwater. These data might be plotted on an outlined lithological map on which the zones in which water is thrown out could also be indicated.

The representation of surface streams upon large-scale maps deserves consideration. The sources of streams frequently lie at different points at different seasons, with the result that many valleys are wet and dry alternately. In Britain this is mainly true in the pervious rocks, and is due to the raising and lowering of the water-table. These periodic stream courses should be accurately represented on all large-scale maps, at any rate down to the "one-inch" map. At present they are either shown as permanent streams or are left out altogether. The importance of the whole question of river flow in the British Isles is now fully recognized. The small river-basins and the large rainfall of Britain make the study particularly interesting in these Islands. We now await the final report upon the first serious investigation in the matter; but it may not be out of place here to refer to the graphic representation of the results of such work. On all the smaller-scaled maps rivers are shown by the conventional line which thickens gradually from source to mouth. It may not be assumed that the thickness is proportional either to the width of the river or to its volume. It will, I think, be agreed that some method of showing more accurately the average volume of water flowing at any point would be

useful for special purposes, and the comparison of such a map with maps showing river-basins, lithology, rainfall, and evaporation would be of high educational value. To make the thickness of line proportional to volume would in most cases be impracticable, as the lines might give a false impression of the width of rivers. But would it not be possible in such special maps as these, to employ a scale of graded colours such as is used in bathymetrical maps, using the lighter tints for small volume and the darker for large volume ?

Climate.

Meteorologists now provide us with full series of daily, monthly, and yearly charts on small scales, showing temperature, pressure, rainfall, etc. for all countries in which stations exist in sufficient numbers to provide the data. They also provide the valuable pilot charts of the oceans. In countries, then, with great wealth of data, the need for development from the geographer's point of view does not lie in the direction of more mapping of general temperature and pressure conditions reduced to sea-level; but rather in the more frequent plotting of actual meteorological conditions on our rugged land surfaces. For instance, in our own Islands we require data for the temperature variations and ranges, and rainfall and evaporation records at different altitudes and exposures, in different parts of the country. All such data when obtained should be plotted on large-scale maps, and the generalized maps reduced from these. The scientific value of such maps is greatly enhanced by the close relationship which their lines would have to the vegetation zones now being mapped by the plant ecologists, and it is certain that these two types of map studied together will be of the highest value in determining to what extent the economic regeneration of our waste lands may be undertaken.

Glaciers.

Glaciers are now recognized as extremely sensitive indicators of climatic change. For this reason alone it would be most desirable that all glaciers be carefully mapped on a large scale (*e.g.* 1 : 10,000) with frequent contours. It is doubly important that this should be done on account of the many scientific problems which glaciology has to solve. In Britain we have no glaciers, but in the British Empire we have; and we should do all in our power to cause the mapping of the glaciers of Canada, India, and New Zealand on the model of the work already done in the Alps by the German-Austrian Alpine Club. A good beginning has been made by the Canadian Alpine Club, under the able leadership of Mr. A. O. Wheeler, by the New Zealand Geological Survey, and in the Himalaya by several private expeditions. In this task the mountain climber has an opportunity to render a signal service to science.

Vegetation.

In recent years the mapping of plant associations as opposed to the distribution of species has made great strides. We have a school of plant

ecologists happily as active in Britain as anywhere—who have shown by their work that by more or less generalization, useful vegetation maps can be constructed on any scale. Thus we have "6-inch" maps for special purposes, "1-inch" sheets scattered over Great Britain, the highlands of Scotland on the scale 1 : 633,600, and the vegetation maps of the continents on various scales in the series of Oxford Wall Maps. Geographers should do everything in their power to encourage this excellent cartographical work by the ecologists. In the British Isles means should be sought for publishing the survey on the "1-inch" scale sheet by sheet as soon as the work has been done. It is greatly to be regretted that the Board of Agriculture has not long ago undertaken this work.

Soil.

In this country the department responsible for topographic mapping is the Board of Agriculture and Fisheries. It is remarkable that British investigations relating to agriculture and fisheries have resulted in so little cartographic representation of data. The scientific study of soils is actively carried on, and it is to be hoped that ere long we may have a systematic soil survey publishing its results in map form. The value of such maps in making agricultural statistics intelligible is evident, and it must be remembered that the ecologist requires a soil map, and at present he must construct his own. Further, the soil map is as essential as the climate and vegetation maps referred to above in discussing the regeneration of waste land. The construction of large-scale soil maps is obviously a matter for the co-operation of the Geological Survey and the Board of Agriculture. The lithological map described above should be studied in conjunction with the soil map to make the latter completely intelligible.

Sea.

In the Government fishery investigations we have a valuable source of oceanographical information, and it is to be hoped that the physical conditions of British waters at different seasons will receive increasing attention in the future, and that the results will receive full cartographical treatment.

Summary.

It may be useful to tabulate the suggestions made above :—

Features shown.	*Requirements.*
Topography.	(1) Ordnance Survey : maintenance of all editions on sale.
	(2) Ordnance Survey : Sale of separate prints from colour-printed maps.
	(3) Atlas of landform types, "1-inch."
	(4) Atlas of landform types, "6-inch."
Landform.	(1) Lithological or structure maps.
	(2) Porosity maps.
	(3) Maps showing degree of resistance.
	(4) "Process" maps, small scale.

Features shown.	*Requirements.*
	(5) "Stage" maps, small scale.
	(6) Distribution maps of various landform types—
	(*a*) as small-scale diagrams;
	(*b*) as large-scale maps.
Hydrography.	(1) Maps showing areas with various types of water-supply.
	(2) Accurate representation of variable headwaters.
	(3) Representation on maps of river volume: method suggested —lines on graduated colour scale.
Climate.	Detailed mapping of actual meteorological conditions in different altitudes and exposures in different parts of the land.
Glaciers.	Detailed large-scaled maps of British Empire glaciers.
Vegetation.	Official publication of "one-inch" vegetation maps of British Isles.
Soil.	Official publication of results of soil surveys.
Sea.	Mapping of all oceanographical data collected on Fishery researches.

It gives the writer the very greatest pleasure, as one occupied with the relatively young study of geography, to acknowledge the great debts which geographers owe to others. The oldest debt of all is to the surveyor and cartographer, who gives definition to what, without him, must be vague statements; a long-standing debt also there is to the geologist, and especially to his younger brother the physiographer. To the botanist, and especially to the plant ecologist, he owes much and will owe still more. He is also in high degree the debtor of meteorologist, oceanographer, biologist, anthropologist, and ethnologist. While fully recognizing that this is so the writer ventures to put forward these few suggestions in the hope that the discussion of them may lead to an increase in the cartographical expression of results obtained by the various sciences. Such an increased wealth of map types must surely help to spread the knowledge of the interdependence of earth sciences which is the spirit of geography.

NOTE.

Since the above was written my attention has been drawn to two recent papers which bear on this subject, and farther, a third work of the kind has since appeared, They are as follows:—

1. W. Behrmann, "Die Oberflächengestaltung des Harzes," in *Forschungen zur Deutschen Landes- und Volkskunde*, vol. **20**, No. 2, 1912.
2. E. Wunderlich, "Die Modernen Vorschläge für kartographische Morphologische Darstellungen," in *Kartographische und Schulgeographische Zeitschrift*, vol. **2**, No. 1, 1913.
3. S. Passarge, 'Morphologischer Atlas,' Lieferung I., "Morphologie des Messtischblattes Stadtremda;" 8 sheets with explanation. Pub. L. Friederichsen & Co., Hamburg, May, 1914. Price 10 marks.

Of these the first is an important morphological study, and it contains, among others, maps showing what the Harz contours would be without marginal valleys, a pre-glacial contour map, and a morphological map in which the various physiographical divisions are plotted.

The second paper is a brief but interesting *résumé* of work done and arguments adduced.

In the third an interesting attempt has been made by Passarge to analyze the land-forms of a small district and to represent the results of the examination in a series of eight maps on the scale of 1 : 50,000. The features shown are as follows:—

1. *Contours and vegetation cover*—viz. Closed, open, or wanting.

2. *Slopes*—represented by a scale of four colours marking areas having gradients respectively of 0°–5°, 5°–20°, 20°–35°, over 35°.

3. *Valley form.* Different types of valley are represented by different tints and by conventional signs.

4. *Geology.* Strata are coloured according to age. The lithological character is made clear in most, though not in all cases.

5. *Power of resistance to mechanical processes.* Account is taken of various qualities, *e.g.* cohesion and firmness, jointing, porosity, capacity for physical change when wet, etc. The scales for each of these are superimposed on the map.

6. *Power of resistance to chemical process.* The rocks are divided into three grades.

7. *Soils.* Not only the chemical and physical composition of the soils is here considered, but also origin and position. Thus, for instance, detritus beds at different levels have different signs.

8. *Historical development of the landforms.* The areas of land surface formed at different periods are distinguished by different colours.

To obtain an estimate of the true value of these maps it is necessary to examine in detail the monograph which accompanies them. And I shall comment here only on such features of the maps as appear to suggest either additions to the matter treated above or modifications of the treatment.

Map 1. Maps showing the thickness of vegetation cover would be useful, especially on the borders of arid or polar regions, and in high mountains.

Map 2. It is obvious that the degree of the slopes must be clearly represented on the map used in discussing landforms; and if the topographic map does not show it, then some such diagram as this must be made. But a carefully hachured map with vertical lighting serves as a diagram of slopes, and gives the plastic effect as well.

Map 3. This map in its character closely resembles that published by Allix, and described above. Maps of this kind will be most useful.

Map 5. The superimposition on this map of the scales for different qualities gives a somewhat confused effect—there are three tints and seven different types of shading. But the map is an interesting experiment; and it and the method of its construction might well form a basis for the discussion by geologists of the possibility of registering the power of resistance of rocks. It must be remembered that the scales are not absolute, but relative for this one district. Only one who knows the ground and the rocks can say if they are reasonable for the district.

Map 6. "Power of resistance" is given two separate maps (5 and 6) for its expression. Of these the second (chemical) is much the simpler; and the determination upon which the map is based also appears to be simple. There is no map of average power of resistance, combining the facts expressed in maps 5 and 6; but in the text (p. 156) the author attempts to give numerical values to this quality in the case of each stratum.

Map 7. For purely geographical purposes it is unnecessary to add anything to the distribution of soils of different chemical and physical composition. The distinction of soils according to level and origin is mainly geological in its purpose.

***Map* 8. It seems to me that the two most important cartographical tasks of the physiographer are the construction of maps of this type and of the type of Map 3. Map 8 is really his *geological* map; on it he expresses the *history* of the surface development. Map 3 is his *geographical* map; on it he plots diagrammatically the *actual forms* which he has classified.**

Sir THOMAS HOLDICH (Vice-President): Before asking you to join in a discussion on the rather technical subject which Mr. Ogilvie has set before us in his address, I have first of all to express my regret for the absence of Colonel Close, who was unable to be here, and also of Mr. Beckit. Both of them have written letters regretting they are unable to be present. I had the advantage some little time ago of reading the paper which Mr. Ogilvie has prepared, which is in all essentials the same as the address he has given us now, and I made a few notes at the time on the subject, which, with your permission, I will read, as they may assist discussion. They refer chiefly to the practical question of attaining such maps as Mr. Ogilvie has suggested.

Mr. Ogilvie does good service in calling attention to the educational value of maps in scientific fields which are not all of them purely geographical. He points out that it is the duty of the geographical societies of this country to procure the publication of selected sheets of the Ordnance Survey in the form of an atlas of typical landforms such as may be found in Germany or the United States. Incidentally he advocates the maintenance of all editions of Ordnance Survey Topographical maps on sale, as well as the sale of separate prints from colour-printed maps. The atlas of landform types he would have on two scales, 1 inch and 6 inch, and then he proceeds to divide his landform maps into six different classes. So far we agree entirely. The value of such maps, if we could get them, no one will question. The question is how to get these maps. To what extent are the geographica societies of this country to be held responsible for their production and maintenance. Up to a certain point there can be no doubt that geographical societies can lend valuable assistance by advice and suggestion. For if the Geographical Society is not an official surveying department itself, it is of little use if it does not foster and encourage the very first elements of map making, and bring all its influence to bear on good map-production. Mr. Ogilvie draws attention to the debt which is owed by the geographer to the cartographer and the surveyor, but it should not be forgotten that it is a debt, and that the opportunity for the geographer, apart from the surveyor, to supply the basis of such technical maps as he recommends (*i.e.* the simple topographical sheets) is very limited indeed. Such maps are not geographical maps at all in the ordinary sense; they are the finished product of a Government department, and all the geographer can do is to criticize methods and results, and occasionally perhaps reproduce for special purposes. As a matter of fact, on the production of the initial maps on which is to be finally grafted all that special information concerning sciences such as geology, botany, meteorology, and the like, the geographer, apart from the official Government surveyor, is not really in it, and all the Geographical Society can do is to bring its influence to bear on the Government Survey Department.

Having obtained the 1-inch and 6-inch sheets required for the landform atlas series, *i.e.* the simple cartographical expression of those forms either by contour or other method of relief, it is obviously necessary to call on the geologist for the elaboration of those further details which are to represent lithology, porosity, resistance, "process," and "stage." I may go further: hydrography, climate, glaciers, vegetation, soil, and sea all demand the treatment of specialists, and all are based on that work

of the surveyor which the Geographical Society does not control. How then could effect best be given to Mr. Ogilvie's recommendations? Assuming that the Geographical Society ought to maintain a directing influence on the production of everything in the nature of a scientific map, it would require a very wide extension of its present office accommodation and financial support to undertake the production of a physical atlas of such importance within its own premises. I am afraid, indeed, that it would be impossible. Neither can we expect that those scientific societies whose interests are involved can undertake map production on a large scale even within the limits of their own special requirements; finally, I doubt the effect of an appeal to Government to extend its mapping interests into fields of speculative public advantage.

With the general expression of Mr. Ogilvie's views, I do not doubt that we all of us agree, although there may be points open to discussion in detail. It would, however, be interesting to know in what practical way he proposes that this Society should give its support to his recommendations.

Colonel W. C. Hedley: I think we should all agree that it is easier to grasp knowledge when explained on a map than when one has to read it up, and we should be very pleased if all these maps could be published. I am afraid, however, that we shall none of us see that done. The topographical maps are, of course, the work of the Ordnance Survey; for lithological and other maps pressure would have to be brought on the Geological Society, and for the vegetation maps application would have to be made to the Board of Agriculture. One very important point is the matter of scale. Small-scale maps are a comparatively simple matter, and if pressure was exercised by this Society and the educational authorities at Oxford and Cambridge it might result in the production of such maps provided the information was supplied to the Ordnance Survey in a satisfactory form, but when it comes to producing a series of maps on the 1-inch and 6-inch scale it is another matter altogether. I think there are about 140 sheets of the 1-inch map in England alone, and for Great Britain this would mean the production and maintenance of some 200 sheets. Before the great expense involved could be incurred it would have to be shown that there was a real demand for such maps. There should be a demand of, say, 500 copies a year: it would not be worth the expense unless there were a real demand of that kind. In the case of the 6-inch maps, I imagine Mr. Ogilvie only meant to suggest that specimen sheets should be produced. I am afraid that his first suggestion that the Ordnance Survey should maintain all editions would prove to be impossible. Perhaps an edition may sometimes be dropped which some people think ought to be maintained, and it is possible, though improbable, that pressure from this and other societies might result in the restoration of certain maps so dropped. Mr. Ogilvie is apparently of opinion that the old series of half-inch maps is for many purposes better than the new. The maintenance of both kinds would hardly be possible. The true solution is an edition which would combine the merits of both. At the present moment I believe a new half-inch map is being engraved which will, we hope, combine the merits of all its predecessors. I think that considerations of storage would make it impossible to keep separate prints from each colour stone of all printed maps, but if anybody wanted copies of any particular sheet he would probably get them at a reasonable price on application to the Director-General of the Ordnance Survey. It would be quite impossible to store different combinations of one, two, or three plates of all the different maps for the whole of England. In designing new maps simplicity and economy ought to be the great consideration. The expense of producing a series of eight forms of maps, each giving some special information, with five or six different colours on each, would be prohibitive for any

large area. Such maps should be based on one of the Ordnance Survey maps, which shows all detail in black. The map would be printed in some lighter colour to allow the special information to stand out plainly. The simpler the form, and the fewer colours you have, the cheaper the maps will be. I think it is a great advantage that maps giving special information should also show the detail, for this makes it possible to identify your position. Without such detail it is very hard to locate a position with any accuracy.

I do not think the method suggested by Mr. Ogilvie for representing the volume of water is a practical one from the printing point of view. The simplest plan would be to print the volume of the water in figures at various points on the river. There would be no difficulty about that at all on a special map prepared to give information with respect to the water. It would not be possible to give such figures on a topographical map, at any rate in England.

Prof. A. P. Brigham, President Amer. Assoc. of Geographers: It gives me a great deal of pleasure to be here this afternoon to hear Mr. Ogilvie. I had the pleasure of being very close to him in an American Pullman car and found him a good companion as well as a good geographer, and with your permission I will read a few words by way of remark.

Through the kindness of the author and of Dr. Keltie, I have had the satisfaction of a preliminary reading of the proofs of this most interesting paper. The demands made upon the geographer at the present time would be appalling if they were not so fascinating and compelling as they are. At no time has geography opened so wide a field for intensive research and for new educational appliances as to-day. Exploration has exposed to us, and described in brief and sketchy fashion, a world of regions which call for precise interpretation. Geology has led us to the new science of geomorphology; and the sciences of man have filed a mountain of unworked material before the geographer.

In this great elaboration, which the younger geographers will have occasion to work out during the next generation, maps will fill a steadily enlarging place. They are almost the only representative material which can afford a correct understanding of remote localities—perhaps I should say—other localities than the one little spot where the geographical expounder happens to be. Pictures, specimens, and even books are complementary to maps, for which geographical education never ceases to call.

Here I base the importance of Mr. Ogilvie's paper. We must have maps by which the principles and facts of the new geography can be put before the eye of millions who will never have the time or taste to master a library. That such maps are not easy to make is to be assumed. The facts of structure, process and stage, are complicated; they vary indefinitely, and in infinite variety as one pass from one region to another. But the task cannot be shunned because it is hard, and I do not see how any one can doubt the goodness of the result, if one quarter of the author's suggestions should be realized. Asa Gray once wrote to Darwin, or possibly it was to Hooker, that he was working on that "rascally genus, the aster." But I do not suppose the botanists have ever thought of giving up the work of classifying asters.

I will not attempt to discuss particular points except to cite in a word a few examples. I remember my surprise some years ago, on visiting a pit at Summertown, in the north of Oxford, at seeing the labourers dip their spades in water and scoop out the clay. The geological map says it is Jurassic, that is, of quite respectable antiquity. But it is yet soft, and has led to the making of a lowland—and a cuesta, if you like the word. I have never seen an adequate—I think I will say a good—map of the Great Appalachian valley. It is a difficult feature to describe, yet its importance, physiographical and historical, is vast. The geological map must make the

zone of the valley look just like the bordering zone of mountains, for in a large part of the extent, the two are parallel. It is hard to explain a valley which is a series of valleys interrupted by long ridges of 500 or 1000 feet altitude. A *resistance map*, if it could be made, would help. I might add that as we have, in the arid regions of the west, much to do with rivers of extreme variability, our topographers use a symbol for intermittent streams. I am sure the idea could be much extended, as Mr. Ogilvie suggests. You are also aware that there is in the United States a Bureau of Soil Survey which has put forth a large number of useful soil maps of selected areas.

I have lately had occasion to say elsewhere that I believed the geographer should build over against his own house. He is likely to under-estimate the value of what to him is familiar and possibly commonplace. But such work is what we need. I think I could make a resistance map of central New York, but I should never have time to learn enough about central England to do it successfully there, even though the conditions are relatively simple. Whatever we gain will be attained through many workers, by a toilsome and often confusing evolution; but we shall attain, and I am confident that Mr. Ogilvie's paper points the way to large and interesting results.

Colonel E. P. Brooker: I am from the Ordnance Survey, and my duties are chiefly in connection with the printing and production of maps. I was extremely interested to hear what Mr. Ogilvie would say about the great possibilities of maps. For statistics and generalized information they excel,—in fact, maps are used frequently by us for other Government Departments to illustrate various statistical information that can best be shown in that way, and I suppose there is practically no limit to the number of maps one could invent to show distribution by different methods of colouring and so forth. As regards Mr. Ogilvie's remarks as to the cheapness of maps, I should like to point out that Ordnance Survey maps are sold now to schools at prices from 1*d.* to 1½*d.* for 200 copies or more, which places schools in the United Kingdom in a better position than the American instance he quoted, where their geological maps are priced about 1*s.* each, so that, as regards cheapness, I think our Government has met that need. The difficulty is as regards numbers. Some people say you cannot expect two hundred copies to be taken, but by a little combination on the part of those interested one would think two hundred is really a very small number if there is really any demand for a map. There are 360 sheets of the 1-inch map which was published from copper in outline with brown hachures. Regret has been expressed that this edition was withdrawn; but it is clear that 360 sheets take a lot of storing, and since it became quite evident that the public did not purchase these maps, it required something more than a few people saying they would like to have them available, for the department to keep them on the catalogue.

I should like to point out that that map is a double printing from copper, and has not the artistic value of the original black edition printed from one plate. Copper plates are not suited for overprinting in that way. If you print a second printing on the first you flatten down the outline and destroy its beautiful sharpness. The ordinary 1-inch coloured edition at present published has the hachures in brown from stone. If these are compared with the edition that was withdrawn, I do not think there is very much difference except that the coloured edition has other information added. I have brought up here examples of the new 1-inch map not quite complete. These will illustrate what Mr. Ogilvie has said that the hachures rather tend to disappear; for, in order to maintain the clearness of the outline the hachures have had to be subdued. I have also brought up some other copies taken from the plates of the hill features only, and I should like to point out that by arrangement such special printings could always be obtained from the Ordnance Survey at rates

corresponding to those at which maps are supplied to schools. The main point as far as it affects Mr. Ogilvie's main contention is that selected sheets can be obtained by special arrangement. When you have these large numbers of sheets covering the whole country, you cannot expect a department to print and keep in stock copies of special maps which may never be asked for. They are for a special purpose, and I would suggest to Mr. Ogilvie that he should adopt the system followed by the Geological Survey, which gets out memoirs for districts and maps to illustrate these memoirs. In that case, I have no doubt special arrangements could be made with both the Ordnance Survey and a publisher by which the maps could be specially printed, much in the same way as we have, on occasion, printed special maps to illustrate books, and sent them to the publisher. Mr. Hinks had some maps which we printed for him to illustrate a very interesting book he wrote. I am sure the Ordnance Survey is always ready to do what it can to meet a definite want.

Rev. H. N. Hutchinson: I should like to say that I attach enormous importance to models. The model of Palestine in the Museum illustrates how much instruction you can get from a model. You can have casts reproduced very cheaply in plaster —one for geology, vegetation, soils, &c., and I think every town that has a Museum ought to have a large model of the country round that town, and teachers and others should bring their pupils and get them round the model, and I think a model can teach a great deal more than a map, because it is the nearest approach to the real thing. I will only put forward the suggestion that models are worth a great deal more than maps.

Sir Thomas Holdich: There are a few remarks in Colonel Close's letter that I ought to read, as he is the responsible head of the Ordnance Survey. Mr. Beckit also sends a few remarks.

Colonel C. F. Close sent the following statement which was read: "As I shall be unable to attend the reading of Mr. Ogilvie's paper on July 2, I should be much obliged if you would kindly have these few remarks read at the meeting.

"Mr. Ogilvie is not quite up to date in his remarks about Ordnance maps. Thus, he talks of the 'wideness of the 100-foot contour.' He is, no doubt, unaware of the fact that on the new type of 1-inch map the contours will be spaced at 50-foot intervals. Then he mentions 'the high price of the official maps.' Here, again, he is no doubt ignorant of the fact that a Departmental Committee is sitting at the present time, which, among other matters, is investigating the question of a possible reduction in price of the small-scale maps. Then he suggests putting 20-foot contours on certain specially selected 6-inch maps. This sort of thing can be done if there is a real and considerable demand for it. But it is 'up to' the schools of geography to come to an agreement with each other and then make a definite suggestion to the Ordnance Survey. Personally I welcome all suggestions tending to make the National maps more useful to all sections of the public, and I should be glad to meet the needs of the geographical schools. But it seems to me that the first thing required is an agreement amongst these schools as to what it is they really want. When they have come to an agreement they might perhaps send representatives to Southampton, and we could then usefully discuss the question as to how far their requirements can be met.

Mr. H. O. Beckit sent the following remarks, which were read: I regret that I am prevented from hearing Mr. Ogilvie's timely and interesting paper. A perusal of his printed text goes a long way towards showing how essential to many, if not most geographical studies is the work of the map-maker. Cartography and geography might surely with mutual advantage move a little more closely hand-in-hand. It will probably be generally agreed that geographers are likely to have to prepare for themselves a good many of the special maps referred to in the paper.

From some little experience of compiling such maps in the course of my own studies and in teaching, I am inclined to venture a criticism of two of Mr. Ogilvie's conclusions. To take the smaller point first, it appears to me dangerous physiographically, to carry very far any classification of land-surfaces that results in placing under one category in relation to stage areas of heterogeneous structure, because they have undergone identical physiographic processes for the same length of time: this will tend toward some confusion, always only too easy, between stage and age. Probably in all small-scale diagrams the difficulty will have to be faced; but I should like to suggest to the author of the paper a second and more general criticism, that he may perhaps be a little premature in deciding, I think more than once, in favour of the wider utility of highly generalized small-scale representations, as against the greater detail only possible on larger scales. It goes without saying that the latter will be more exact. That is not the point, but rather that in the really exploratory work of settling many new cartographic methods that will be necessary, the essentially simpler though multiple problems of the larger scales will more safely be tackled first. With most of what is contained in Mr. Ogilvie's paper I should like, in conclusion, to express very hearty agreement—an agreement, I imagine, that will be generally shared by all who are interested in the rational progress of geography, especially on the physical side.

Mr. OGILVIE: I should like to begin by offering my thanks for all the criticisms and suggestions which have been made upon the paper. This is a paper which I hoped would be discussed and criticized, and I am glad to have set the ball rolling. The discussion has given me several welcome pieces of news regarding the Ordnance Survey. From Colonel Close I learn that the contour interval of all "1-inch" maps is in future to be 50 feet. This is a great improvement. Secondly, we have heard that there is some idea of reducing prices, and Colonel Hedley tells us that we may look forward to an improved "half-inch" map. I gather from Colonel Hedley's remarks that I have not made my meaning clear as regards the suggested atlases of landform types. In speaking of proposed atlases on two scales I did not intend to imply that they would include large numbers of sheets, but a small collection of carefully selected maps published at a low price. I should take as models the United States Atlas of Physiographic types and the "Forty maps of the German Empire, 1:100,000." The latter are published for educational purposes at about 2*d.* per sheet. A short description of each sheet was written by Dr. Behrmann and issued by the Geographical Society of Berlin. I thank Colonel Close for the assurance that the co-operation of the schools of geography by suggestions on their part would be welcomed by him. I feel sure that the geographical schools would be only too pleased to help in the selection of Ordnance sheets for such atlases.

Colonel Brooker reminds us of the facilities given to schools in purchasing Ordnance maps. I referred to that in the paper, and I did not consider that the provision met the requirement under discussion. But Colonel Brooker's remarks give me the idea that perhaps the existing regulations would prove sufficiently elastic to give us the "1-inch" landform atlas without delay. Let us say that forty British maps be selected, and that two hundred sets of them, as a minimum, were published at 1*d.* or 1½*d.* per sheet, I am convinced that there would be no difficulty in selling every set. Thus, by altering slightly the present regulation, and by careful selection of maps, knowledge of the main types of British landform would at once be spread throughout the country.*

* Colonel Brooker afterwards indicated that this arrangement would probably be practicable, and he further pointed out that for such a collection of maps special printings—as referred to in the paper—could probably be included.

I am much obliged to Colonel Brooker for bringing examples of the new 1-inch map, and especially for showing us the half-printed map. Nothing could be more graphic than this beautiful and delicately tinted map of the relief of South Devon. But comparison of this map showing relief only with the completed map shows that my remarks apply even more to this new edition than to the old. For the addition of the boldly printed "outline detail," by its great contrast, renders the relief even less effective than in the old map. Colonel Brooker says that the public did not purchase the engraved map. I think there are two reasons for this: first, that the public were not educated to appreciate relief on maps; but teachers now claim with reason that the public is learning, and the best instrument for teaching them has been withdrawn. But probably the map was not purchased even by all teachers for the second of my reasons, viz. that the map was never properly advertised.

I recognize that the brown engraved map as an engraving is somewhat inferior to the earlier black map. But I presumed it would be useless to attempt the restoration of a map which disappeared at a still earlier date. Moreover, I think that the best of the shades of brown which was used appeals to the eye in a remarkable way.

Colonel Hedley raised the question of storage difficulties. If the necessary funds can really not be procured to provide for the preservation of the stones or plates of all editions, or even for a reserve stock of printed maps, I would suggest a small reform in procedure which might go some way to meeting the difficulty which has arisen. I suggest that, before any edition is withdrawn, the fact be well advertised by the agents and by special notice to geographical societies and teaching institutions, of which a list should be kept by the Ordnance Survey. In this way institutions or individuals would be given an opportunity of purchasing, before withdrawals, copies which they would otherwise have obtained more gradually.

As Colonel Hedley says, the production of a variety of colour-printed maps showing different features of the same area is expensive. But the eight maps referred to (of Passarge's Atlas) are sold at 10s. I do not suggest that such map-production be undertaken wholesale by any one. These maps should be published merely in illustration of special studies.

I wish to thank Prof. Brigham for coming here to-day, and for his remarks. I ought to have referred to the excellent "soil" maps of the United States of which he spoke; but my mind was occupied rather with maps which exist or do not exist in this country.

I agree with Mr. Hutchinson in his reference to the educational value of models; but their bulk must greatly limit their use. In my paper I was, of course, discussing maps only.

I am specially glad to have Mr. Beckit's criticism of this paper. I am conscious that, however difficult it may be to find a method of mapping the distribution of anything on a large scale, a satisfactory method can generally be found; while small-scale mapping always has hanging over it the danger of false generalization. I think the small-scale diagrams are wanted as handy references to the broader features, since they can easily be made accessible to all. But I agree with Mr. Beckit that the generalized plotting and the cartographic methods to be adopted for the small scales will be better done after the detailed maps have been made on larger scales. I think that Mr. Beckit's other criticism is just; I have probably underestimated the danger to which he refers. I think, however, that generalized "stage" maps can usefully be drawn without making the element of time a criterion in marking out the areas.

And now in answer to the Chairman's question as to the manner in which the geographical societies can help in getting the various tasks accomplished. I would

indicate the parts which might with advantage be played by the various bodies in helping to attain the desired object.

As Colonel Close points out, the schools of geography should come to an agreement as to the precise nature of the various maps required in teaching and in geographical research. Where these maps would be the product of Government departments, and where they might be obtained without much additional cost to the State, the schools should endeavour by conference with the departments concerned to arrange for their production.

Where the production of such maps would involve considerable expenditure by a Government department, the geographical societies must take the matter in hand, provided, of course, that they are satisfied that the proposal is worthy of their support. It would then be the duty of the societies to point out to the responsible member of the Government the scientific and educational value to geography of the work for which they are asking sanction. Moreover, it might not be out of place for a scientific society to point out to the Government the practical utility to the country of such work. The utility of even the maps of the Geological Survey has not always been recognized by those in authority. And if they had now been persuaded by scientists, for instance, that the vegetation survey has a practical value, ministers might review the whole question of the potential values of uncultivated land with the knowledge that their statements were based upon the results of scientific work.

A great number of the map types which I have mentioned do not fall to be produced by Government departments, but would naturally appear as illustrations of papers read to this and other societies. Now I suggest that the geographical societies should remind other societies of the points in which their respective scopes coincide, and let it be known that the cartographic expression of results in all work done on these border zones of the sciences would be welcomed by geographers. Under certain circumstances this Society might well share with other societies the cost of producing maps interesting to both.

REVIEWS.

EUROPE.

'Lombard Towns of Italy.' By Egerton R. Williams. (London: Smith, Elder. 1914. Pp. 561. *Price* 7*s.* 6*d. net. Map. Illustrations.*) Mr. Williams' third volume of his trilogy on North Italian cities describes the historic towns of Lombardy. In this study we are reminded of Italy's struggles for independence, and also of our indebtedness to Lombardy for our present form of Anglican ritual. The towns dealt with *in extenso* are Pavia, with its magnificent Certosa; Mantua, the beloved of Virgil; Bergamo; Monza, with its famous Iron Crown, coveted and fought for during many centuries; Saronno; Varese; Lodi, and Crema. History, art, literature, all have a share in the interest of the author, and are entered into as fully as is possible in a single volume, for some of these towns could hardly be exhaustively described if each had a volume to itself.

'Rome. A Practical Guide to Rome and its Environs.' By Eustace Reynolds Ball. (London: A. & C. Black. 1913. *Price* 2*s.* 6*d.*) 'A Handbook to Rome and its Environs.' (London: Ward, Lock & Co. *Price* 2*s.* 6*d. net.*) Both of these guide-books appear to do full justice to the incomparable sights and

monuments of the Eternal City. The former contains a useful account of Commendatore Boni's excavations, which brings modern research up to date. On the other hand, Messrs. Ward, Lock & Co.'s book is richer in its illustrations and maps, though it might have been more convenient if the general map of Rome had been contained in one sheet instead of being divided into three longitudinal sections. A small key-plan of the entire city partly atones for this drawback. The illustrations, etc., to Mr. Reynolds-Ball's volume (borrowed from another volume published by Messrs. Black) are artistically coloured. A bibliography of the principal popular books dealing with Roman history, archæology, art, and topography published within the last few years, as well as some of the standard works on the same lines, forms a useful appendix to Messrs. Black's publication.

ASIA.

Cyprus.

'Griechische Sitten und Gebräuche auf Cypern.' By Magda H. Ohnefalsch-Richter. Berlin: D. Reimer. 1913. *Map and Illustrations.* 16 *M.*

Cyprus has an especial interest for all of us who are concerned with the anthropogeography of the Mediterranean, as it represents the meeting-place of East and West in both ancient and modern times. Frau Ohnefalsch-Richter has had more opportunities than most for studying the place and people, as she has accompanied her husband on so many of his archæological expeditions, and her book covers a much wider ground than the title suggests. First we have the kind of information we should find in an official handbook, for instance, a chemical analysis of the wine and the condition of the export trade. On the other hand, the book is full of information gleaned from the people themselves, of folklore, of descriptions of primitive customs, and so on. For example, attention is called to the potters of Phynè, who still make their pots without a wheel as did their predecessors in the Bronze Age, and we have a description with photographs of an Aphrodite feast at Larnaka. In fact, we have a most complete list of those things in Cyprus, both cultural and technological, which seem to be survivals of the Bronze Age or other ancient cultures, and we cannot but be grateful for a collection of facts which are day by day becoming more difficult to obtain. Of the present Frau Richter has also much to say, but she often fails to draw a distinction between those things which are essentially Cypriot and those which are common to all or a considerable part of the Near East. We are often left to suppose that a particular culture is centred and centred only in Cyprus.

The history of the island also comes in for due mention, and we are told, what we could well spare, the tale of the recent struggle for the archbishopric. The natural features of the island are treated in a general way, and there is a specially interesting notice of the flora and fauna with reference to their relation to mankind. Many excellent photographs are incorporated in the book, and they serve to bring home the life of the Cypriots better than anything else. It will be seen, then, that Frau Richter has treated the subject from many points of view, but we cannot help feeling that the book, while full of information, is addressed rather to the general reader or to the traveller than to the student of geography; until, however, a more serious book appears it supplies in a convenient form much useful information.

L. H. D. B.

AMERICA.

Bolivia.

'La Bolivie et Ses Mines.' By Paul Walle. Pp. xvi, 444. *Photographs and Maps.* Paris: E. Guilmoto. 1913. 7.50 *fr.*

Bolivia is emerging from its isolation. M. Paul Walle, in the course of his work in connection with the French Ministère du Commerce, visited the country in 1911–12, after an interval of twelve years. He was struck by the distinct progress which had been made, and became aware of an awakening which foreshadows the results which will ensue when the Panama canal is normally in use. His book describes the country in detail from the point of view of the man of business, yet the geographer will find therein a mine of information. From the first chapter, which describes the routes by which the traveller may journey to Bolivia, to the last chapter, which deals with openings for French commerce, the book is intensely practical, yet, with the assistance of the admirable map appended to the book, the reader may glean from the text an idea of the geographical conditions of Bolivia which will serve as a unique illustration of a country in the New World, dependent almost entirely upon its mineral resources, historically famous as one of the richest sources of precious metals—the wealth of Potosi is legendary—yet suffering from its altitude and its isolation, and only now feeling the modern impulse towards the construction of railways on which the very future of the state depends.

Bolivia, in the present and the past, implies the source of silver and tin; yet Bolivia, of the future, will be a much greater country, notable for its agricultural products. Hitherto only the plateau has been exploited; yet roughly half the country lies on the lowland to the east of the cordillera, where there is a great variety of vegetation, and an immense possibility of future production. The forests yield rubber, timber for all purposes, gums of varied kind; the grassy plains are at present practically uninhabited. Contrasted with the high plateau, the lowlands are exceptionally fertile, in consequence of the alluvium regularly fed to the soil by the multitudinous rivers which send water to the Amazon or the Plate. This area, of an enormous potential productivity, is cut off from the world by the barrier of the Cordillera, and awaits the railway and the colonist.

The high plateaux include two regions—the lower land, from 1 to 2 miles above sea-level, with a gentle climate and a varied vegetation, and an extremely varied relief; and the higher land, from 2 miles in elevation up to the snow-line, which is roughly 3 miles above the sea. The lower plateaux yield practically all the vegetable produce required for home consumption—coffee of notable excellence, cocoa, cane-sugar. Cocoa alone is exported to neighbouring lands.

The virtual capital, La Paz, is reached by railway from Antofagasta, in Chile, or from Mollendo, in Peru. This forms the main railway line in the country, yet the branch lines, either constructed or under construction, are important connections gradually joining the mines with the ports just named. At present the journey from Europe to La Paz takes about twenty-eight to thirty days, and the minimum cost is about £50; but when rail connection is completed between the systems of Bolivia and Argentina viâ Uyuni and Tapiza, there will be a saving both in time and money.

The awakening of Bolivia is indicated by the following table, which has been compiled from M. Walle's statistics. Imports and exports have trebled in a decade; rubber production has doubled in seven years. The production of silver has seen various changes, due to two causes—first, the decline

in value of the metal; but secondly, and of greater importance, the transference of the interest of the miner from silver to tin. Tin and bismuth are of increasing importance; but the production of copper depends upon the price of the metal. When copper fetches £70 a ton in Europe, copper mining in Bolivia just pays its expenses, and the great rise in 1912 is due to the high price which prevailed.

Year.	Trade in million pounds		Rubber. Million pounds.	Minerals in thousand tons.			
	Imports.	Exports.		Silver.	Tin.	Copper.	Bismuth.
1912	4·0	7·2	*7·9	0·12	38	4·7	0·38
			(Percentages)				
1903	33	28	—	133	55	85	—
1904	35	35	—	84	58	68	
1905	40	46	42	75	74	98	
1906	60	61	53	92	76	94	52†
1907	75	55	50	125	74	75	
1908	80	54	72	133	79	64	
1909	68	71	86	133	95	66	
1910	98	84	86	117	102	68	80
1911	115	91	100	108	97	68	106
1912	100	100	—	100	100	100	100

B. C. W.

Countries of South America.

'South American Handbooks.' London: Sir Isaac Pitman & Sons. 1914. *Maps and Illustrations.* 6s. *net each.*

From time to time notices have appeared in the *Journal* of volumes in Mr. T. Fisher Unwin's "South American Series." Sir Isaac Pitman & Sons are publishing a similar series under the general title "South American Handbooks." The first four of these handbooks are 'North Brazil' and 'South Brazil' (both by Mr. E. C. Buley), 'Peru' (by Mr. E. C. Vivian), and 'Colombia' (by Mr. V. Lévine). The volumes are both smaller and cheaper than those in Mr. Fisher Unwin's series, but are equally comprehensive in scope and adhere more closely to a general plan. The four under notice range in length from 216 pages to 235 pages, demy octavo. From a description of the physical conditions they pass through the flora and fauna to man and his varied activities—his history in the country, present distribution, political organization, finance, social conditions, means of transport, resources and industries, and foreign trade. Finally comes an alphabetical list of the chief towns, with notes on each, while appendices give information about such matters as money, weights and measures, posts and telegraphs, steamship lines, and diplomatic representatives. At the beginning is a map of the country under discussion, at the end a small general map of South America, and among the illustrations a sketch-map of the country's waterways and railways. Photographic illustrations number from thirteen to fifteen. An index is provided. Briefly, the aim seems to have been to produce concise, practical works of reference, and this has been well attained in the volumes under notice. It should be observed that in the handbooks of North and South Brazil many of the pages are identical in the chapters on climate and health,

* 1911. † Average 1904–1909.

history and settlement, constitution and defence, federal finance, social conditions, imports and exports. The appendices are also the same, as are two of the three maps. In any future edition, the river descended by Mr. Roosevelt will need to be marked on the maps and included in the list of chief rivers.

'Ten Thousand Miles with a Dog Sled.' By Archdeacon Hudson Stuck. (New York: Scribner's Sons. 1914. Pp. xix., 420. *Map and Illustrations.* $3.50.) The Archdeacon of the Yukon, known to geographers for his 'Ascent of Denali (Mount McKinley),' here describes his extensive journeys in Alaska, with much detail of geographical and allied interest, illustrated by excellent scenic photographs. He ranges over the middle and part of the lower valley of the Yukon and much of those of its tributaries the Porcupine, Tanana, and Koyukuk, and also discusses journeys over three separate routes through the country between the Yukon and the Alaska ranges to the south, in the Seward peninsula, along the Kobuk river, and elsewhere. On conditions and methods of living and of travel in this difficult region, on climatic conditions, as well as on social and other aspects of Alaska, he writes with interest and authority.

'The real Mexico. A Study on the Spot.' By H. Hamilton Fyfe. (London: Heinemann. 1914. Pp. viii. and 247. *Map.* 6*s. net.*) Mr. Fyfe's picturesque narratives, based on his experiences in the most diverse parts of the world, are so well known that to say this collection of letters on a recent autumn tour through Mexico is quite typical and worthy of his facile pen, is to give it no small commendation. The letters are, of course, republished from the journals for which Mr. Fyfe acted as special correspondent. Interspersed with pictures of social existence and everyday life, outdoors and indoors, are character sketches of the chief personages who have figured in the exciting public events of the last few years. The *coup d'œil* is one of bewildering variety and continual movement, but it is difficult to draw or deduce therefrom any general conclusion as to the immediate future of this interesting but puzzling corner of the New World. Sooner or later it is bound to play a great part in the development of the almost boundless West.

'Handbook of Jamaica.' By J. C. Ford and F. Cundall, F.S.A. (London: Stanford. 1914. Pp. viii. and 652. *Map.* 6*s. net.*) This quasi-official publication has now reached its thirty-fourth year. It contains many features which render it almost indispensable to residents—official or otherwise. It is at once a gazetteer and directory, a Government handbook, and a traveller's guidebook. A glance at the contents pages and index is a sufficent indication of the conscientious and painstaking methods of the editor. The portion intended for tourists is unusually complete, and includes full details of the local communications, accommodation, principal attractions, amusements, sporting facilities, etc.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Wave Studies.

'Waves of Sand and Snow and the Eddies which make them.' By Vaughan Cornish. London: T. Fisher Unwin. [1914.] *Map and Illustrations.* 10*s. net.*

Fifty years ago J. F. Campbell wrote a delightful book under the title 'Frost and Fire—Natural Engines, Tool-marks, and Chips, with Sketches at Home and Abroad by a Traveller.' The subject was an old one, but his treatment of it and his diagrammatic generalizations were always interesting,

and often highly suggestive, even where they might be somewhat whimsical. Not the least interesting section of his work is the short part on "Deposition by the 'engines' air and water, working with the 'tools' wind and waves, and characterized by many and varied 'tool-marks.'" Since 1865 the observations and investigations of physicists and engineers have provided much guidance for the study of wave-prints in nature, and Dr. Vaughan Cornish made the reading of their work a preliminary to his own. He has, however, approached the subject in the same out-of-doors spirit as J. F. Campbell did, and he too has collected his instances for observation and record from the wide field of a traveller.

In 'Waves of Sand and Snow and the Eddies which make them' we have eighty beautiful plates, in which the author fully maintains his high standard in photography, and thirty figures in the text—a comprehensive and valuable record of tool-marks which are more or less known to all who have eyes to see. These are illustrations of some of the sandhills, snowdrifts, and sandbanks which Dr. Vaughan Cornish has examined, watched, and measured in the last twenty years, and in this volume he has brought together for more popular exposition many of the results which he has published from time to time in scientific journals. The book may be read with profit by a wide public, as it is nowhere so technical as to demand special knowledge from the reader, and those who have seen much of sand and snow will thank the author for bringing before them many points of interest which they have hitherto missed.

The author's method is to give in considerable detail the narrative of his own experiments and journeys of observation in the field, followed by his explanations of the phenomena described. While the method adopted is scientific, many readers will regret that Dr. Vaughan Cornish has not gone a little further, and pointed out where his conclusions are in agreement and where in disagreement with those of previous writers. In fact, the appearance of a book intended for general readers which is based upon the work of a single observer emphasizes the need for a work which will correlate the results, physical and geographical, of all the observers of waves of this kind, and will give references to their writings; and the literature, at any rate of sand-dunes, is extensive.

In the mean time we have in 'Waves of Sand and Snow,' a work which should perform a very useful function in impressing on its readers the great value of patient and careful observation in the field.

As regards the illustrations, there is a slight criticism which may be offered by more serious students. As the subject is one in which the illustration of form is so important, it is to be regretted that the actual waves—of sand or snow—which were photographed were not also shown by contoured sketch-maps. These would form a useful supplement to the clear diagrams which accompany the text.

A. G. O.

GENERAL.

Ocean Commerce.

(1) 'Ocean Trading and Shipping.' By Douglas Owen. Pp. 277. Cambridge Naval and Military Series. Cambridge University Press. 10*s.* 6*d. net.*

The first chapter of this book is of the greatest interest to the geographer: it is replete with suggestive ideas concerning ports and the causes of their success. Chapter II. deals with ships, their ownership and measurement, and especially with the machinery which must be set in operation before a ship can

be employed upon a trading voyage: the chief instruments are, of course, the charterparty and the bill of lading, and specimens of these documents are included in a pocket at the end of the book. Lloyd's, and all that Lloyd's means, is explained in Chapter III., and the rest of the book is devoted to importing and exporting, with special reference to the new circumstances which affect ships when war is declared. The reader owes much to Mr. Owen for the clarity and completeness of his exposition, but the geographer, we repeat, is in his debt for the excellence of the first chapter, which should be read by all teachers of geography.

(2) 'Die Grundlagen der Schiffahrtsstatistik. Ein kritischer Beitrag zur Wertung der Handelsflotte und des Seeverkehrs des Deutschen Reiches. By Dr. Walther Vogel. ('Veröffentlichungen des Instituts für Meereskunde an der Universität Berlin.' Heft 16. September, 1911. Re-issue: Heft 1. Historisch-volkwirtschaftliche Reihe.) Pp. 154. *Diagrams.*

This re-issue of an important communication concerning shipping and sea traffic permits us to call attention to the value of the volume on account of both its parts. The first part contains a summary of the official publications dealing with shipping, a statement of the various methods of measurement employed in the case of merchant ships, and of the errors which may arise from these methods. The second part consists of an attempt to lay bare the progress which has been made in connection with the German mercantile marine since 1874.

All those students of geography or of economics who have attempted to make comparative studies of the merchant fleets of the great trading nations will have experienced difficulty in finding a common measure which will furnish a basis for comparative statistics. Part I. of Dr. Vogel's book will be of immense help in the case of future studies of this kind. It does not remove the difficulties, but it makes the student's path easier.

The statistical inquiry into the growth of German shipping is admirably illustrated by means of diagrams, from one of which we gather almost at a glance the great disproportion which has always existed between the use made of Hamburg and Bremen and the use made of the other German ports. In addition to this disproportion we note that most of the other ports have suffered decline steadily during three decades, and that the out-ports of the Elbe and Weser do not yet hold a high place in regard either to number of ships or of tonnage. From a second diagram it becomes clear that in the cases of the United Kingdom, Denmark, Sweden, and Norway the bulk of the German trade is still in the hands of ships flying the foreign, *i.e.* non-German flag, *e.g.* in the case of German trade with the United Kingdom half the tonnage is under the British flag, and a third is German.

B. C. W.

Coast Economy.

'Coast Sand Dunes, Sand Spits, and Sand Wastes.' By G. O. Case. Pp. 162. 1914. 5*s. net.*

'The Use of Vegetation for reclaiming Tidal Lands.' By G. O. Case. Pp. 36. London: St. Bride's Press. 1913. 2*s. net.*

The first of these volumes is a most useful little book crammed with facts culled from all parts of the world and well illustrated with photographic reproductions and diagrams. Numerous references to other works are given. Mr.

Case discusses the formation and distribution of sand dunes and the devastation caused by them when they move inland, and then goes on to consider protective works and the reclamation of sand wastes. If we have one criticism to offer it is that the book is too condensed. There is certainly not a superfluous paragraph. The author particularly advocates the construction of protective coast dunes to prevent inland sand drift, and to allow existing areas of sand waste to be reclaimed and converted into woods. On this subject the book expands a little.

The second volume is a reprint of several articles which appeared in *Engineering* last year. It is very slight, but gives a useful summary of the subject.

Educational Books.

(1) 'The Teaching of Geography and History.' (Pp. 132. 1*s. net.*) (2) 'Our Island History.' (Pp. 320. 2*s.*) (3) 'The Modern British State.' (Pp. 270. 1*s.* 9*d.*) By H. J. Mackinder. London: Geo. Philip & Son. 1914.

The first of these three books redeems a promise made by Mr. Mackinder that he would indicate the lines along which the teacher should lead his pupils in the early stages of geography before use is made of books, and a second promise that he would provide a teachers' commentary upon the volumes in his series 'Elementary Studies in Geography and History.' It suffices to say that Mr. Mackinder has redeemed his promise in a book which is at the same time stimulating and practical.

In 'Our Island History' Mr. Mackinder endeavours "to give a sense of the stream of time, so that the present may be realized as the outcome of the past." The stream rises in Julius Cæsar, and passes many well-known landmarks until it reaches St. Augustine, when it receives tributaries from Scotland and Ireland, and flows on by Alfred, William I., and Edward I., and becomes a flowing current through the spacious Tudor times till it reaches Oliver Cromwell and Dutch William; it then trickles onwards *viâ* Walpole and Nelson to end at George Stephenson.

'The Modern British State' "aims at giving a description of the social organism which is known as the United Kingdom," and succeeds in a striking and novel fashion in introducing the pupil to the study of civics.

'A Laboratory Manual for Physical and Commercial Geography.' By R. S. Tarr and O. D. von Engeln. New York: The Macmillan Co. 1913.

This manual has been prepared for use in the high schools, the normal schools, and colleges of the United States. There is a series of lessons, for each of which is provided a statement of the purpose of the exercise, a list of the apparatus required, and one or more pages on which there are printed questions each followed by a space in which the reply may be written. The complete set is so arranged that the separate pages may be withdrawn from the stout paper covers and used, and then rebound in the order in which the exercises have been completed. The subject matter is comprehensive, and, although the exercises upon the topographical maps refer entirely to portions of the United States contoured maps, British teachers will find much that is suggestive and helpful in this manual.

The Oxford Geographies. 'The World and its Discovery.' By H. B. Wetherill. Pp. 318. *Maps*. The Clarendon Press. 3*s*. 6*d*.

The aim of this book is to supply an introduction to the study of the geography of a continent by means of stories of discovery. The continents are taken in the order: Africa, Asia, America, and Australia. Six chapters, for instance, are given to the voyages of Hanno, Cadamosto, da Gama, the travels of Park and Livingstone, the search for the Nile sources, and the relief of Emin Pasha by Stanley, and the seventh chapter summarizes the geography of the continent.

Mr. Wetherill has been at pains to intersperse explanations of the prominent geographical circumstances which arise in connection with each story, and has added some helpful maps.

'The British Isles.' By F. Mort. Pp. xii., 232. *Maps and Illustrations*. Cambridge: University Press. 1914. 3*s*.

Mr. Mort provides the pupil with an excellent introduction to the detailed study of the British Isles, since he gives the main features of the geography of the homeland in perspective and in correlation. His maps and pictorial illustrations are excellent.

'A Little Book on Map Projection.' By Mary Adams. Pp. 108. *Diagrams*. Geo. Philip & Sons. 2*s*. *net*.

It is a sign of the times that Miss Adams has written such a useful and teachable account of the various map projections, so shortly after the appearance of Mr. Hinks's authoritative work on the same subject, to which she acknowledges her debt. An illustration of the real usefulness of this little book may be seen in the following summary of the suggestions for teaching the properties of the sphere in regard to its plane sections: take a box with a perfectly plane top edge, fill it with clay, or plasticine, or foûnder's sand, press a ball, *e.g.* a billiard ball, into the material, remove the surplus material above the plane of the box top, remove the ball and examine the mould which is left.

B. C. W.

'The British Empire beyond the Seas.' By Marion I. Newbigin. (London: Bell. 1914. Pp. xii., 351. *Maps*. 3*s*. 6*d*.) This is a good descriptive geography, commendably free of the formality and dryness of many text-books, and yet not too discursive. The territories of the Empire are arranged on a mainly climatic basis under four sections—regions with cool or cold winters, regions with warm summers and mild winters (in which the whole of the Australian continent is for convenience included, though the arrangement is not wholly satisfactory), hot regions with extensive native cultivation, and hot regions with little native cultivation. The arrangement of the two last sections is ingenious and instructive. This reasoned classification, though explained clearly on broad lines, might perhaps have been kept more constantly in view throughout the descriptive paragraphs. The maps and diagrams are for the most part clear and good.

'The Pan-Angles.' By Sinclair Kennedy. (London: Longmans, Green. 1914. Pp. x., 244. *Map*. 7*s*. 6*d*.) Under this cacophonous but perhaps unavoidable title the writer discusses the federation of the "Seven English-speaking nations"—the British Isles, Canada, Newfoundland, South Africa,

Australia, New Zealand, and the United States. In so far as he is careful to furnish references throughout and frequently, the book is a valuable index to much that has been written and spoken concerning federation and allied topics of imperial interest, nor is it without value to have summarized and clearly presented the case for British imperial federation; but the case for the inclusion of the United States is less clear, and the probable standpoint of that confederation in the matter is not so fully worked out.

THE MONTHLY RECORD.

ASIA.

The Turco-Persian Frontier.—The work of the Turco-Persian Frontier Commission (*Journal*, vol. **42**, pp. 492, 570) was successfully completed on October 28, twenty-four hours before the inception of hostilities against Russia by Turkey. The last pillar was erected, under the supervision of the British, Persian, Russian, and Turkish Commissioners, on October 26 at the foot of Mount Ararat, on the slopes of which the Turco-Persian frontier unites with the Turco-Russian frontier. By an interesting coincidence a Turco-Russian Commission, which had been re-erecting fallen pillars and effecting certain minor adjustments of frontier, also finished its work during October. The total length of frontier, from Fao to Ararat, as finally demarcated, was about 1200 miles. Practically the whole of the frontier is shown on new maps, specially prepared for the Commission, usually on the 1 mile = 1 inch or 2 verst = 1 inch scales, by the British and Russian survey parties attached to the Commission; the former being supplied by the Survey of India, and commanded by Lieut.-Colonel C. H. Ryder, D.S.O., R.E., with whom was Major H. McCowie, R.E. It remains to be seen how far subsequent events have rendered the Commission's labours nugatory, but it may be confidently anticipated that in the south the frontier that has been laid down will be accepted as the frontier between Persia and the newly acquired British territory of Mesopotamia; and in the north, likewise, it will constitute the frontier between the Persian province of Azarbaijan and the newly conquered territories of Russia in Armenia. The British Commission did not pass unscathed through the lawless regions traversed by the frontier, Mr. G. E. Hubbard, Levant Consular Service—the secretary to the British Commissioner—being severely wounded in the course of a treacherous attack by some Kurds upon a party of British officers belonging to the Commission.

Dr. F. de Filippi's Expedition.—We have received two letters from Dr. de Filippi, the first sent from Yarkand on October 3, the second from Tashkent on November 18, reporting briefly on the last stages of his expedition, which had completed its whole programme by the second date (cf. *Journal*, vol. **43**, pp. 32, 672; **44**, p. 407). In the first letter he states that the extremely bad weather and the flooded rivers frustrated all attempts to reach the Oprang river, though two of his companions—Wood * and Spranger—had, in spite of difficulties, completed the survey of the whole upper basin of the Yarkand river. The party were busy at Yarkand with the gravity station, and purposed to make another at Kashgar and a last at Tashkent, thus connecting the Indian stations and the whole chain occupied by the expedition with the Russian series. The second letter reports the successful execution of this purpose, thus completing the expedition's work. Dr. de Filippi

* Major H. Wood, of the Indian Trigonometrical Survey, who joined the expedition early last year with two Indian surveyors.

hoped to return to Italy *viâ* Bukarest, and to send us from thence a fourth and last report on the work of his expedition.

Recent Coast Erosion at Morib, Selangor.—Mr. C. Strickland, M.A., B.C. CANTAB., sends us some notes on a case of recent rapid erosion of the coast at Morib, a small seaside resort in Selangor somewhat frequented by Europeans. A metalled road which ran at right angles to the sea is said to have been washed away to the extent of 100 yards, a gentleman's garden has lost 30 feet in one year, and stumps of coconuts now stand in the sea some distance from the land, while others lie fallen or are ready to fall. The erosion is localized within a narrow area, and as the trouble is nearly conterminous with the area here cleared and planted with coconuts, it might be thought that the destruction of the original jungle was in some way responsible. But as clearings have not resulted in erosion in other parts of the coast, this does not seem to be the case. Nor does the cause appear to have been the removal of a belt of mangrove, for erosion is proceeding apace behind some of the thickest and best-grown mangrove. Mr. Strickland calls attention to the existence, elsewhere along the coast, of a long narrow barrier of sand and humus, raised several feet above the surface of the land behind it, and covered by soft short grass and casuarinas—probably a storm beach raised by the south-west monsoon. This, he thinks, was probably once continuous, but has been washed away in front of Morib. The cause would seem to have been the cutting of a road drain 10 to 15 feet wide down to the sea at the spot where erosion has been greatest, at the apex of the bight now occupied by the sea. The soft barrier would be easily washed away on its cut flanks by the scour of the drainage and of the tides, where the frontal assault of the sea had previously no effect; every particle of the barrier having lost its lateral *point d'appui*. Now that the process has been started it is bound to continue until some other natural or artificial cause stops its progress, the alluvial formation washing away quickly under the frontal assault of the sea, even where its lateral action has been checked by the erection of masonry. The facts well illustrate the protection given by a storm beach to an alluvial tract behind it, the impregnability of the barrier to a frontal assault, its weakness when pierced, and the failure of the alluvium to withstand a *frontal* attack when exposed by the loss of the barrier.

AFRICA.

Railways in Fernando Po.—A beginning has already been made with the opening up of this Spanish West African island by means of railways, and it is proposed to gradually extend the system until all the more important economic areas are linked in this way with the capital—Santa Isabel, on the north coast. A sketch of the programme suggested, based on a report by Commandant del Rio Joan, appeared last year in the *Revista de Geografía Colonial* of the Madrid Geographical Society. The most important line, part of which is already under construction, is that connecting the capital with the bay of San Carlos on the west coast, and traversing the whole western versant of the island, on which the most important areas of settlement are situated. By keeping somewhat inland it will avoid crossing the more difficult, deeper, parts of the valleys, though not reaching a greater altitude than 300 metres. Its length will be about 45 kilometres. A second projected line is one from Santa Isabel to the bay of Concepcion on the east coast and thence to the southern extremity of the island: this will encounter somewhat greater obstacles than the first, and will have a length of 70 kilometres. Two transverse lines are also suggested, one connecting San Carlos with Concepcion, the other serving the settlements along the southern coast.

AMERICA

Miss Keen's Glacier Explorations in Alaska.—Miss Dora Keen, whose enterprising first (partial) ascent of Mount Blackburn, in the Wrangel mountains east of the Copper river in Alaska, was recorded in the *Journal* for August, 1912 (vol. **40**, p. 217), sends us a short account of an expedition carried out last summer to the glaciers of the Prince William sound region, undertaken at the suggestion of Prof. L. Martin, one of the previous workers in this field.* Her expedition, which left Valdez on August 15, included Messrs. Handy (her guide up Mount Blackburn), Rabehl, and Tucker, all of them experienced in glacier work, Mr. Tucker having been a member of the Parker-Brown expedition which partially ascended Mount McKinley in 1910, and in the Yale party which made the first ascent of Coropuna in Peru in 1911. The first object of the expedition was to explore and map the hitherto unvisited portion of the Chugach mountains in which the Harvard glacier has its origin.† It was hoped that, by ascending this, a crossing of the range might be effected to the Matanuska glacier on the farther side, returning by the valley of the same name. The Harvard glacier has a tidal ice cliff 350 feet high and 1¼ mile wide, approach to which is dangerous by reason of the constantly falling ice. A landing was, however, effected, but seracs made travel on the glacier impossible, so that the supplies (including fuel) had to be painfully relayed for seven miles by a difficult way at the edge of the ice. Getting at last on to the glacier itself, the party pushed on another 9 miles over endless crevasses, but was then brought to a halt by the shattered state of the ice. The divide lay some 10 miles beyond up Brunonian glacier—as the main north-western tributary was named—apparently at an elevation of about 7500 feet. Owing to the hard going and bad weather this trip occupied nearly four weeks, but it resulted in material for the first map of this hitherto unvisited region, with observations of snowfall, temperature, etc. The second main object of the expedition was the observation of the glaciers of College fiord, Harriman fiord, and Columbia bay,‡ in order to ascertain what changes had taken place since the visits of previous observers. To this end photographs of all the leading glaciers (some twenty in all) were made, from the stations occupied by the earlier expeditions. In many cases evidence of recent advance or retreat of nearly a quarter of a mile was found, and the data secured may throw light on the question whether the changes noted are due to climatic variations or to earthquakes.

The Cape Cod Canal, cutting through the neck of land which joined the hook-shaped peninsula of Cape Cod to the mainland, and so considerably shortening the sea route between Boston and New York, was opened to traffic on July 29 of last year. A short account of the undertaking and of the interests which will be served by the new canal appears in the November number of the *Bulletin* of the American Geographical Society, illustrated by a sketch-map. The length of the canal, from

* The glaciers debouching on the various ramifications of Prince William sound have been seen by visitors to this region from the time of Vancouver's great expedition onwards, but have been scientifically explored only within recent years. Some of them were examined or at least photographed from a distance by the Harriman Alaska expedition, the results being given in vol. **3** of the detailed reports of that expedition. Later researches are those of Messrs. Grant and Higgins (recorded in *Bulletin* U.S. Geol. Survey, No. 526), and of Prof. Martin (*Zeitschrift für Gletscherkunde*, vol. **7**, pp. 289 *seq.*).—[Ed.]

† Harvard glacier debouches into the head of College fiord, the north-eastern branch of Port Wells, itself the north-western indentation of Prince William sound.

‡ Harriman fiord is a western arm of Port Wells, and Colombia bay, a northern indentation of Prince William sound east of Port Wells.

the head of Cape Cod bay in the north-east to that of Buzzard's bay in the south-west, is 7½ miles, most of the distance being already trenched by natural drainage, so that only 1 mile passes through higher ground, rising to a maximum of 29 feet. Approach channels dredged in the sea at either end raise the total length to 13 miles. The channel has a width at bottom of 100 feet, with a depth of 25 feet at mean low water. The waterway is at sea-level throughout, and though there is a maximum difference of tide-level between the two ends of some 5 feet, this is not enough to cause inconvenience. There are two passing-places within the canal proper. Whereas the distance from New York to Boston by the old route round Cape Cod is 334 statute miles, by the canal it is only 272, so that the reduction is very appreciable, and the avoidance of the storms and fogs of the outside route is an additional gain. The commerce passing round Cape Cod is estimated at 25,000,000 tons yearly, coal and lumber being the principal cargoes, carried in towed barges and steamers.

AUSTRALASIA AND PACIFIC ISLANDS.

Expedition to the Coral Reefs of Torres Straits.—An expedition for the study of these reefs has lately been carried out by a party under the leadership of Dr. A. G. Mayer, on behalf of the Department of Marine Biology of the Carnegie Institution of Washington. It arrived at Thursday island early in September, 1913, intending to work in that locality, but on finding the reefs there to be overwhelmed by a layer of mud, changed its plans, and with some difficulty found its way to the Murray islands, lying in the lee of the northern end of the Great Barrier reef. Investigations were continued here for some time, and a general account of the party's work and experiences has been given by Dr. Mayer in the *Popular Science Monthly* for September, 1914. Most of the time was spent on Maer island, the largest of the group—an extinct volcano which in its active days burst through the old limestone floor of the Barrier reef plateau. On the western side the crater rim rises to a height of 750 feet, falling steeply to the sea. The northern half is formed by a mass of lava which flowed out as the result of an explosion of later times, when the northern part of the crater rim was destroyed. After the cessation of activity, corals began to grow along the shores, and have surrounded the island with a fringing reef. This has grown outwards, particularly on the south-east, the side exposed to the trade wind and the force of the waves, leaving a shallow lagoon behind it. Dr. Mayer, whose previous studies of coral formations entitle him to speak with authority, says that it is quite clear that the island has not developed in the midst of a pre-existing reef-flat, but that the volcano took shape before the modern reefs began to form round it. In their character of fringing reefs they are quite distinct from barrier reefs, which, with Penck and others, Dr. Mayer considers to have originated as breakwaters upon the seaward edge of previously existing platforms dating from the glacial epoch. The characteristic feature of the Pacific reefs—the Lithothamnion ridge, formed where the breakers strike with full force—is well developed on the south-eastern reef of Maer island, completly enclosing a shallow marine lake. Some forty species of coral grow upon the reef-flat, the delicate and profusely branched *Seriatopora histrix* being the dominant species in the middle zone. The region is never visited by hurricanes, and there is a vast array of small coral heads instead of the large ones which alone can thrive in more exposed regions. A careful survey of the corals in a line across the reef emphasized the tendency for the corals to grow best at considerable distances from the shore, probably owing to their inability to stand high temperatures, especially if liable to be buried by sand or mud. In the lagoon the variations in the water temperature were found to be much greater than those of the air. Dr. Mayer considers that the

constant outward advance of the Lithothamnion ridge proves that the older portions must be progressively dissolved, and that if this action cannot be ascribed to the sea-water some other agency must be accountable. Other biological studies were carried out by Dr. Mayer's coadjutors, among whom was Mr. F. A. Potts, of Cambridge.

Dutch Exploration in the Mamberamo Basin, New Guinea.—A Dutch military detachment, under Captain Oppermann, continued the exploration of the great Mamberamo river in north-western New Guinea during 1914, and has secured some interesting results. A survey of the lower course of the river introduced changes and improvements in the map, which has hitherto depended on the survey of Lieut. Kerkhoven in 1884. Several new tributaries were discovered, and the previously reported Lake Rombebai, lying east of the main river, near the head of the deltaic region, was examined. It proved to have an extent of 16 by 8 kilometres, and to be surrounded by a girdle of swamps. The depth reaches something like 20 fathoms, and it appears to be filled by the water of the Mamberamo, with which it is connected by a short channel. The programme included an exploration of two important streams entering the main river from the west in its middle and upper course. The higher of these, named the Rouffaer by Captain Herderschee during his expedition of 1910,* was ascended for some distance by Lieut. Stroeve, who found that by its direction and general importance it is entitled to rank as the main upper course of the Mamberamo, and is likely to afford a good means of approach to the central range. Instead of coming from the north or west, its direction is from the west-south-west, and it reaches a breadth of a kilometre in places, with a good many islands. The banks are well peopled, but the inhabitants were not inclined to be friendly. This discovery led to a modification of the plans of the expedition, it being felt that this river would be a better line of advance for the further survey work towards the mountains than the branch ascended by Herderschee. This preliminary account of the work of the party appeared in the *Tijdschrift* of the Netherlands Geographical Society for September last, further reference being made to it in the next number (November). This gives the melancholy intelligence of the death of Lieut. Stroeve (who had previously done good exploring work on the coasts of Geelvink bay) during an attack in force by the natives. This occurred in September, apparently not on the Mamberamo, but on Geelvink bay.

POLAR REGIONS.

Sir E. Shackleton's Expedition.—It was announced from Melbourne on December 15 that the *Aurora*, the vessel of Sir E. Shackleton's expedition carrying a supporting party to the Ross sea, had sailed for Hobart *en route* for the Antarctic. As already mentioned, this party is under the command of Lieut. McIntosh.

The Anglo-Swedish Antarctic Expedition.—We are informed by Prof. Otto Nordenskjöld that it has been decided to postpone the start of this expedition (*Journal*, vol. **43**, p. 554) until 1916. Apart from the impossibility of enjoying the proposed British co-operation under present circumstances, it is felt that the war, so long as it lasts, would render the fitting out of the expedition extremely difficult. It is hoped, however, that the original programme for a joint expedition may be carried out without change under happier conditions.

Commemoration of American Antarctic Explorers.—The American Geographical Society has lately commemorated the Antarctic explorers, Wilkes and Palmer, by erecting in the lower hall of its house two bronze tablets, each measuring 39 by 17 inches, the step having been taken at the instance of Mr. E. S. Balch,

* *Geographical Journal*, Vol. **36**, p. 497.

whose persevering efforts to secure due recognition for the work of his compatriots are already well known to geographers. Reproductions of the tablets are given in the *Bulletin* of the American Geographical Society for November last. Each contains, above a suitable inscription, a representation in relief of a scene relating to the explorations of the respective navigators. The one shows Wilkes' ship, the *Peacock*, in contact with icebergs in the Antarctic ocean; the other Palmer's Land in West Antarctica, named after Captain Nathaniel B. Palmer, probably the first to sight (in 1820–21) the Antarctic mainland nearest to South America. Although the accuracy of Wilkes' reports of extensive land seen during the course of his voyage has sometimes been questioned (and no doubt in some cases he may have been misled by appearances of land at spots where none exists), his voyage was a remarkable achievement, and the general correctness of his claims is now generally recognized.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Mediæval Climate.*—Dr. Norlind discusses this subject in the paper noted below, the main contribution in which is a table (pp. 21–39) stating the general weather conditions in Europe during the years 709 to 1499, and the usefulness of this compilation is increased by the references to the original records on which it is based. This valuable list is accompanied by a discussion of its evidence, of the freezing of the Baltic and Kattegat, and of the floods on the coasts of Frisian Germany. The author dismisses these floods as of little significance, as they are dependent upon the repair of the dykes. He makes a detailed comparison of the winter and summer weathers for each year for which there are data, between 1121 and 1310; summarizing the results in an interesting chart, based on ten-year averages, of the succession of severe winters and of moist cool summers. The chart shows, as is not surprising, that the summer is usually cold and wet when the winter is mild. The evidence shows a certain periodicity in the weather and during the period dealt with the winter maxima occurred at intervals of 25, 45, 50, and 35 years: as the author remarks, these lengths naturally call to mind Brückner's period. He concludes that owing to the insufficiency of the material, no trace of any greater period can be discovered, but he adds that the records leave him with a presentiment (*Ahnung*) that in comparison with the present, the winter was formerly colder, though to an insignificant extent. The author remarks that the records collected do not establish any very definite conclusions: they therefore support his opinion that the weather has been in general uniform throughout the historic period, and that there can have been nothing more than very slight changes from the existing conditions.

Forms of River-Valleys.—This subject is dealt with by Mr. J. Lyon Rich in the *Journal of Geology* (Chicago) for July–August, 1914. The writer considers that existing literature fails to adequately explain differences in form from a genetic point of view, and endeavours to supply the need, holding that an understanding of the distinctive forms of valleys, and consequent ability to determine the processes which have been at work in their formation, will supply a valuable aid to reading the physical history of the region in which they occur. He distinguishes three main types of valleys by the terms (1) the Open valley, with comparatively straight walls between which the stream swings in broad open curves; (2) the Intrenched Meander valley (the "incised meandering valley" of Davis and others, which last term Mr. Rich would use equally for this and the third type),

* 'Einige Bemerkungen über das Klima der Historischen Zeit nebst einem Verzeichnis Mittelalterlicher Witterungserscheinungen.' Von Dr. A. Norlind. Lunds Universitets Årsskrift, N.F. Afd. 1, Vol. 10, No. 1, 1914, 55 pp.

cut into the rock with little modification of the course inherited from a previous erosion cycle; and (3) the Ingrown Meander valley, in which the meanders have either originated or expanded as the stream sank its channel lower. To understand the method of formation of each of these it is necessary to consider the three main processes by which a valley is developed—vertical down-cutting, lateral cutting, and down-valley migration of the meanders, to which the term "sweep" is applied by Davis. The writer discusses the causes and effects of the dominance of one or other of these processes, or their combination in one and the same case. Sweep, and particularly the ratio of the rate of sweep to that of down-cutting, appears to play a fundamental part in determining the form of the valley, and its dominance may be expected in (1) a stream at grade in a relatively straight valley; (2) a stream which for any reason has ceased down-cutting; and (3) a stream carrying coarse material, which implies a high gradient (favourable to down-valley migration), and is a check to down-cutting. The rate of down-cutting is, of course, closely correlated with differing rates of uplift of a region, and Mr. Rich considers the varying effects of these on streams of different original characters. Slow uplift (unless so slow that sweep dominates) will tend towards the formation of the ingrown type of meander, while a rapid uplift will result in the intrenchment of the stream in its original course, whether meandering or not; if relatively straight, a valley of the open type will develop. The general conclusion is that while dominant sweep produces type 1, the open valley; and dominant down-cutting, either type 1 or type 2; the third type only arises from a nicely balanced relation between the three processes, down-cutting being relatively slow and yet rapid enough to make sweep subordinate.

GENERAL.

Newly-discovered Map by Juan Vespucci. The Buccaneer's Atlas.—An interesting document has lately come to light in the form of a large MS. map of the World by Juan Vespucci, dated 1526, and measuring no less than 8 feet in length. It has passed through the hands of Mr. Quaritch, who has issued a pamphlet describing the map, and reproducing the portion representing Central America and part of the West Indian islands.* The find is an important one as, apart from a small engraved map of the World on an equidistant polar projection (reproduced by Harrisse in his 'Discovery of America'), no sample of the author's work appears to have previously been known. Juan Vespucci was the nephew of his more celebrated namesake, Amerigo, and, as mentioned by Harrisse in the work just quoted, has been known as a capable pilot and cartographer from various documents that have come down to us. He is referred to by Peter Martyr in 1514 as "Magister nauclerus," and he acted as head pilot of the expedition of that year to Darien under Pedrarias Davila. In 1526 he was appointed (with another) to examine pilots in the place of Sebastian Cabot, who had sailed in command of an expedition to Brazil. The newly-found map will therefore well repay careful study by competent experts. As in other maps of the period, there are considerable errors in longitude, especially in the New World. Thus the coast of North America extends through far too many degrees of longitude. From the details given in the pamphlet it appears that, as in other maps of the time (and even considerably later), the opening to the Gulf of St. Lawrence between Newfoundland and Cape Breton island is merely shown as a bay, with land continuous to the north. The island of San Juan (placed by other map-

* Mr. Quaritch informs us that the map has been purchased by the Hispanic Society of America, by which so much has been done to popularize a knowledge of early maps. It is to be hoped that a facsimile may in time be issued.

makers near Cape Breton) is here placed close to Cape Race. From the reproduction given of Central America, Juan Vespucci's map would seem to show some affinity with the Maiollo map of 1527, the "Stretto dubitoso" of which (intersecting the Isthmus of Tehuantepec) is represented by a gulf with uncertain termination running far into the southern coast-line. But whereas Yucatan was eroneously shown as an island by Maiollo (as by Verrazzano, Ribero, and several others) it is connected by Vespucci with the mainland by a narrow neck. The representation of the east coast of Central America (further east and south) is inferior to that of Ribero, though it is not greatly bettered in some maps of a later date, such as the 'Isolario' of Alonso de Santa Cruz (about 1541) or Sebastian Cabot's well-known map of 1544. The Pacific coast stops short at the eastern side of the Bay of Panama. Mr. Quaritch has also offered for sale an interesting item of a later date, viz. a collection of pictorial charts of the Pacific coasts of America, entitled the 'Buccaneer's Atlas, or South Sea Waggoner.' The charts were drawn by William Hack, of Wapping (compiler of the small collection of voyages published in 1699), about 1684, and the volume was formerly in the possession of the South Sea Company. Reproductions of one of the maps and of the upper cover are given in the pamphlet.

Commemoration of Drake's Landing on the Coast of California.—Miss J. M. Hyde, of Inverness, California, sends us a photograph of the wooden cross erected several years ago near Drake's landing-place on the coast north of San Francisco. The spot was lately (September 1, 1914) the scene of a commemoration service, conducted by the Rev. Irving Spencer, probably the first since that held there by Drake himself at his landing in 1579. It is planned to hold a service every June, and hopes are entertained that a suitable monument may in time be erected. Miss Hyde also sends photographs of Drake's bay taken from the headland on which the cross is placed, and of the white cliffs spoken of by him, which suggested the name of New Albion.

OBITUARY.

William Woodville Rockhill.

In Mr. W. W. Rockhill, whose death occurred at Honolulu early in December, the United States lose a public servant who not only distinguished himself in his professional career as a diplomatist, but gained a world-wide reputation as a traveller and orientalist. Born at Philadelphia, in 1854, the son of Thomas C. Rockhill, of Baltimore, he entered the diplomatic service, in which his whole official life was spent, in 1884, becoming in turn Second and First Secretary at the American Legation at Peking. In 1888 he undertook the first of his great journeys in the interior of the Chinese Empire, which gained him the Patron's Medal of our Society in 1893. His knowledge of the Tibetan language, and his familiarity with the manners and customs of the peoples with whom he had to do, gave him unusual qualifications for the task, and though he failed in his plan of reaching Lhasa, he returned to China by Ta-chien-lu after accomplishing a valuable journey through Koko-Nor, Tsaidam, and Eastern Tibet. The narrative of this journey was given in 'The Land of the Lamas,' which appeared in 1891, and shed much new light on the geography and peoples of those regions. In 1891–92 he carried out a still more extensive journey, pushing south across the headwaters of the Yang-tse (Murussu or Dichu)—the sources of which he approached more closely than any European in modern times—and reaching a point on the road to Lhasa in 32° N. He was then compelled once more to turn east, but in so doing traversed a previously almost unknown area of

Eastern Tibet lying between the outward and return routes of A—K in 1879–82. A new volume entitled 'Diary of a Journey through Mongolia and Tibet in 1891 and 1892,' appeared from his pen in 1894. Mr. Rockhill's official duties in the Department of State at Washington kept him at home for some years after his return from this journey, but between 1897 and 1899 he represented the United States as Minister to Greece, Bulgaria, and Servia. In 1900, after a brief interval as Director of the Bureau of American Republics, he returned to China as U.S. Commissioner and Plenipotentiary, becoming Minister in 1905. Between 1910 and 1913 (when he retired) he filled the same office in turn at St. Petersburg and Constantinople. In the midst of these official duties he found time to continue his studies of things Eastern, and, among other services, he edited for this Society the volume by Sarat Chandra Das on his 'Journey to Lhasa and Central Tibet,' and for the Hakluyt Society the 'Journey of Friar William of Rubruck.' He had been an Honorary Corresponding Member of our Society since 1897.

Henry Gannett.

The well-known American geographer, Mr. Henry Gannett, died early in November, aged 68. Educated at Harvard University and Bowdoin College, he worked for a time as civil and mining engineer, and subsequently as Assistant at Harvard Observatory. His more definite connection with geography began in 1872, when he became topographer to the Hayden Survey of the interior territories of the United States—a position which he retained till 1879. His subsequent work was rather administrative and statistical than concerned with survey in the field. He had much to do with the organization of the U.S. Geological Survey, to which he for many years acted as Chief Geographer. He was also Geographer to the successive censuses of 1880, 1890, and 1900, and took a prominent part in the work of the census of the Philippines in 1902–03, as well as that of Cuba in 1907–08. Other posts held by him were those of Chairman of the U.S. Board on Geographic Names and Geographer to the Conservation Commission. His publications were largely of the nature of statistical compilations, for which he possessed particular aptitudes. Among these were the 'Statistical Atlases' of the above-mentioned censuses; the 'Dictionary of Altitudes of the United States'; A Monograph on the 'Boundaries of the United States,' both as a whole and individually; and Gazetteers of many of the separate states. He also was part editor of 'Scribner's Statistical Atlas.' Of more general geographical interest was his volume on the United States in 'Stanford's Compendium,' and his 'Commercial Geography,' published, in conjunction with two other writers, in 1908. His work for the U.S. Geological Survey was embodied in various 'Bulletins' and 'Professional Papers' of that department, and he also contributed many papers to Geographical serials.

Richard Nicklin Hall.

We much regret to record the death, announced from Bulawayo in November, of Mr. R. N. Hall, well known for his investigations of the ruins in Mashonaland, of the antiquity of which he was an enthusiastic champion. Mr. Hall, who was born in 1853, was son of Joseph Hall, J.P., of Dudley, Worcestershire. A solicitor by profession, he acted as political agent to various members of Parliament, including Sir Edward Reed, K.C.B. Going out to South Africa, he soon identified himself with the activities of the young British colony of Rhodesia, filling, among other posts, those of secretary to the Bulawayo Chamber of Commerce and editor of the *Matabele Times*. It was at Mr. Rhodes' suggestion that he first undertook the exploration

of the Zimbabwe and other ruins in Southern Rhodesia, the results of which he published, in conjunction with Mr. W. G. Neal, in the interesting volume 'The Ancient Ruins of Rhodesia' (1902; 2nd ed., 1904). This did much to arouse a popular interest in the ruins, besides bringing to light many sites previously unknown to experts. Subsequently, when the view was put forward that none of the ruins were of any great antiquity, or assignable to other than Negro builders, he vigorously contested this (to his mind) heretical doctrine, and returned more than once to the scene of his former work, in the hope of supporting his case by fresh evidence. The results of his further researches were embodied in 1909 in his 'Pre-historic Rhodesia.' Only last year his services were recognized by the South African Government by his appointment as 'Curator of the Ancient Monuments of Rhodesia,' including, besides ruins, such relics as Bushman paintings, to which he had also devoted some attention, and on which he was understood to be preparing a new work for publication.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1914–1915.

Second Meeting, November 23, 1914.—Douglas W. Freshfield, Esq., President, in the Chair.

Elections.—*G. Anscombe; Miss Dorothy Barber; Mrs. William Nelthorpe de Vere Beauclerk; Captain Clive Behrens, late R.F.A.; Hilaire Belloc; Leonard Biddulph; Ralph Carpenter Blanchard; Lieut.-Comm. Francis G. Brickenden, R.N.; Miss Bessie Georgina Brown; Colin William Burnley Campbell; Frederick Taylor Campbell; Arthur d'Arcy Eugene Chapman, B.A.; Mrs. Lewis Chase; M. B. Dalal; Charles Edward Jesser Davis; George Dovers; Mrs. Charlotte Doveton; Percy James Drought; Robert Lewis Drouyn; Mrs. Charles Dummett; Charles Sumner Durst; Harry Walker Eastcott; Austin Eastwood; Reginald Ellis; Mrs. G. Foaker; Benjamin Apthorp Gould Fuller; Mrs. Gwendolen Gascoigne; Newton W. Gilbert; B. Cunninghame Graham; Mrs. Horace Egerton Green; Samuel Hugh Francklin Hole; Alfred Holt; Herbert Frank Howe; Arthur James; Sirdar Charanjit Singh of Kapurthala; Miss Elsie Kilvert; Captain L. N. F. I. King, R.E.; William Seaton King; Lady Eileen Knox; Miss Constance Lidderdale; Manoel de Oliveira Lima; Fortescue Long; Miss Mary Lumsden; Captain Malcolm Neynoe MacLeod, R.E.; Charles Campbell McLeod; Arthur J. Moore-Bennett; John Morgan; Rev. Gresham Wynter Morrison; Roy Norton; William Robert Patterson; Captain Albert William Pearse; Sydney James Pearson; John Percival; Miss Fanny A. Plowright; Mrs. Horatio G. Powell; John Pratt; James C. Renshaw; Miss Ethel Bradley Robinson; Hewitt Douglas Rodger; Rev. S. B. Rohold; Nicholas Romanoff; Captain W. H. I. Shakespear, I.A.; Charles Frank Smythe; Rt. Hon. Sir Cecil A. Spring-Rice, G.C.V.O., K.C.M.G.; Captain C. Steele, 13th Hussars; Mrs. Nancy Yulee Stigand; John Swift; Rev. Charles Samuel Tator; Edward Reginald Taylor; Captain O. H. B. Trenchard, R.E.; Cecil Wacher; Miss Eleanor Warne, B.A.; Langdon Warner; Charles H. Wells; Mrs. Arminel Werring; Lt.-Comm. Eric Lloyd Wharton, R.N.; Lady White; Rev. Walter G. White, M.A.; A. H. Williams; Richard Wilson; Lieut. Frank Arthur Worsley, R.N.R.; Otto Christian Zimmermann.*

The paper read was:—

"The Mental Training of a Traveller." By the Right Hon. Viscount Bryce, O.M.

Third Meeting, December 7, 1914.—Douglas W. Freshfield, Esq., President, in the Chair.

Elections.—*William David Elder; Rev. Frank Hutchinson; Mrs. Agnes J. S. McKinnon; Commander Frank Powell-Brown; Reginald A. G. Travers; Omar Asar Turvey, C.E., Ph.D.; Stanley Vandeleur Mills.*

The paper read was:—
"Types of Political Frontiers in Europe." By Prof. L. W. Lyde.

Fourth Meeting, December 9, 1914.—Douglas W. Freshfield, Esq., President, in the Chair.

The paper read was:—
"Frontier Work on the Bolivia-Brazil Boundary." By Captain H. A. Edwards.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are as a rule written in full:—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Col. = Colonies.
Com. = Commerce.
C.R. = Comptes Rendus.
E. = Erdkunde.
G. = Geography, Géographie, Geografia.
Gen. = Genootschap.
Ges. = Gesellschaft.
I. = Institute, Institution.
Int. = International.
Iz. = Izvestiya.
J. = Journal.
Jb. = Jahrbuch.
Jber. = Jahresbericht.
k.(k.) = kaiserlich (und königlich).
M. = Mitteilungen.
Mag. = Magazine.
Mem. (Mém.) = Memoirs, Mémoires.
Met. (mét.) = Meteorological.
P. = Proceedings.
R. = Royal.
Rev. (Riv.) = Review, Revue, Rivista.
S. = Society, Société, Selskab.
Sc. = Science(s).
Sitzb. = Sitzungsbericht.
T. = Transactions.
Ts. = Tijdschrift, Tidskrift.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Adriatic—Tides. *Ann. Hydrographie* **42** (1914): 220–225, 270–281. **Defant.**
Zur Theorie der Gezeiten im Adriatischen Meere. Von Dr. A. Defant. *Sketch-map and Diagrams.*

Albania—Early maps. *B.R.S.G. (Rome)* Ser. V. **3** (1914): 601–637. **Almagià.**
Le più antiche rappresentazioni cartografiche della regione albanese. By Roberto Almagià. *Facsimiles.*

Alps—Glaciation. *Z. Gletscherkunde* **8** (1914) : 226–262. **Klebelsberg.**

Glazialgeologische Notizen vom bayrischen Alpenrande, III. und IV. Von Dr. R. v. Klebelsberg. III. Der Ammergau und sein glaziales Einzugsgebiet. IV. Die Voralpen zwischen Loisach und Isar (Krottenkopf-Walchensee-Jachenau und das Vorland der Benediktenwand). *Maps and Illustrations.*

Alps—Mont Blanc. *Petermanns M., Ergänzsht.* Nr. 181 : pp. vii. and 187. **Lucerna.**

Morphologie der Montblancgruppe. Von Dr. Roman Lucerna. *Maps and Illustrations.*

Baltic. **Ruppin.**

Beitrag zur Hydrographie der Belt- und Ostsee. Von Ernst Ruppin. (Aus dem Laboratorium für internationale Meeresforschung in Kiel. Hydrographische Abteilung, Nr. 10.) (Abhandlung 8 aus *Wissenchaftliche Meeresuntersuchungen*, Neue Folge, 14. Band. Abteilung Kiel.) Kiel: Schmidt & Klaunig, 1912. Size $12\frac{1}{2} \times 10\frac{1}{2}$, pp. 209–272. *Sketch-map and Illustrations.*

Baltic—Tides. *Ann. Hydrographie* **42** (1914): 183–208. **Brehmer.**

Tiden von langer Periode im mittleren Wasserstande der Ostsee zu Swinemünde. Von Dr. Brehmer.

Germany—Harz—Gravity. **Galle.**

Das Geoid im Harz. Von Prof. Dr. A. Galle. (Veröffent. K. Preuss. Geodät. Inst., N.F. Nr. 61.) Berlin, 1914. Size 12 × 9, pp. 101. *Maps, Illustrations, and Stereoscopic Representation.*

Germany—Magnetism. **Wolff.**

Erdmagnetische Untersuchungen im Zobtengebirge. Von Hans G. Wolff. (Veröffent. K. Preuss. Meteor. Inst., Nr. 277, Abh. Bd. V. Nr. 1.) *Maps.*

Germany—Mecklenburg—Limnology. **Portmann.**

Tiefenverhältnisse von mecklenburgischen Seentypen. Von Wilhelm Portmann. (Mitteilungen aus der Grossherzogl. Mecklenburg. Geologischen Landesanstalt, XXV.) Rostock, 1913. Size $11\frac{1}{2} \times 9$, pp. 35. *Map.*

Germany—Pomerania. *XIV. Jber. G. Ges. Greifswald*, 1913–14 (1914): 1–318. **Dreyer.**

Die Moore Pommerns, ihre geographische Bedingtheit und wirtschaftsgeographische Bedeutung. Von Dr. Johann Dreyer. *Maps and Illustrations.*

Germany—Pomerania. **Praesent.**

XIV. Jber. G. Ges. Greifswald, 1913–14 (1914): 333–356.

Beiträge zur Kenntnis des Greifswalden Boddens I. Vorläufiger Bericht über die hydrographischen Untersuchungen des Geographischen Institutes der Universität im Greifswalder Bodden. Von Hans Praesent. *Charts.*

Germany—Riesen-Gebirge. **Nafe.**

Die Schneegruben des Riesengebirges und ihre Enstehung. Ein Beitrag zur Theorie der Karbildung von Professor Otto Nafe. (K. Gymnasium zu Hirschberg i. Schl., Beilage zum Jber. Ostern 1914.) Size 11 × 9, pp. 47. *Chart and Diagrams.*

Iceland—Climate. *G. Ts.* **22** (1914): 204–216. **Thoroddsen.**

Islands Klima i Oldtiden. Af Dr. Th. Thoroddsen.

Italy—Lake of Lugano. **Ghezzi.**

Progetto per la Sistemazione del Lago Ceresio (Lago di Lugano) di C. Ghezzi. (Dipart. fed. Interno: Comunicazioni della Div. dell' Idrografia Nazionale, No. 4.) Bern : Rösch & Schatzmann, 1913. Size $8\frac{1}{2} \times 5\frac{1}{2}$, pp. 48. *Diagrams. Also Atlas*, size 15 × 10.

Italy—Valtellina. **Saragat.**

B.R.S.G. (*Rome*) Ser. V. **3** (1914): 403–427, 527–556, 638–662.

La Geografia fisica della Valtellina. By Aurelio Saragat. *Illustrations.*

Mediterranean. *B.R.S.G.* (*Rome*) Ser. V. **3** (1914): 670–680. **Vinciguerra.**

La Conferenza di Roma per l'esplorazione del Mediterraneo. By Decio Vinciguerra. *Sketch-map.*

Norway—Precipitation.

Nedboriagttagelser i Norge. Utgit av det Norske Meteorologiske Institut. Aargang XVIII., 1912. [With supplement separate.] Kristiania : H. Aschehoug

& Co., 1914. Size 14 × 11, pp. 65, (suppl.) 49. *Maps and Illustrations. Price Kr.* 3.00.

Servia. *B.S. Serbe G.* **3** and **4** (1914): 1–23. **Cvijić.**

La Position Géographique de la Serbie actuelle. Par J. Cvijić. [In Servian; French *résumé*.]

United Kingdom—Somersetshire—Maps. **Chubb.**

A descriptive list of the printed maps of Somersetshire, 1575–1914. Size 9½ × 5½, pp. xii. and 230. *Maps. Price* 10*s.*

United Kingdom—Sussex—Place-names. **Roberts.**

The Place-names of Sussex. By R. G. Roberts. Cambridge: University Press, 1914. Size 9 × 5½, pp. xxxii. and 210. *Price* 10*s. net. Presented.*

ASIA.

Baluchistan—Fauna. **Zugmayer and Laubmann.**

Abh. K. Bayerischen A.W., Math.-phys. Klasse (1913): No. 6, pp. 35; (1914); No. 9, pp. 71.

Wissenschaftliche Ergebnisse der Reise von Dr. Erich Zugmayer in Balutschistan 1911. Die Fische von Balutschistan. Mit einleinden Bemerkungen über die Fauna des Landes. Von Erich Zugmayer. [The same.] Vögel. Von A. Laubmann. *Illustrations.*

Ceylon—Historical. **Pieris.**

Ceylon. The Portuguese era. Being a history of the Island for the period 1505–1658. By P. E. Pieris. 2 vols. Colombo, 1913. Size 9 × 5½, pp. (vol. 1) xxvi. and 390; (vol. 2) viii. and 628. *Maps and Illustrations. Presented.*

China—Travel. **Gaunt.**

A woman in China. By Mary Gaunt. London: T. Werner Laurie, [1914]. Size 9 × 5½, pp. xvi. and 390. *Illustrations. Price* 15*s. net. Presented.*

China—Travel. **Hosie.**

On the Trail of the Opium Poppy. A narrative of travel in the chief opium-producing provinces of China. By Sir Alexander Hosie. 2 vols. London: G. Philip & Son, 1914. Size 9½ × 6, pp. (vol. 1) viii. and 300; (vol. 2) 308. *Maps and Illustrations. Price* 25*s. net. Presented.*

China—Yunnan—Geology. **Brown.**

Records Geol. Survey India **43–44** (1913–14): *passim.*

Contributions to the geology of the province of Yünnan, in Western China. By J. Coggin Brown. *Maps and Illustrations.*

India—Cotton. *Asiatic Rev.* **5** (1914): 298–364. **Summers.**

Development of cotton in India: Sind, a second Egypt. By Dr. T. Summers, *Sketch-map and Section.*

India—Goa. **Mendonça and Telles.**

A. Sc. Lisboa, B. da Segunda Classe **4** (1910–1911): 50–76, 77–95.

Centenario da Tomada de Goa. Affonso de Albuquerque e Tristão da Cunhã. By Henrique Lopes de Mendonça. Goa: Estudo de Geomorphologia. By Silva Telles.

India—Historical. **Foster.**

The English factories in India, 1646–1650. A calendar of documents in the India Office, Westminster. By William Foster. Size 9 × 6, pp. xxxii. and 362. *Illustrations. Price* 12*s.* 6*d. net. Presented.*

Japan. **Mabie.**

Japan: To-day and To-morrow. By Hamilton Wright Mabie. New York: The Macmillan Company, 1914. Size 8½ × 5½, pp. 292. *Illustrations. Price* 8*s.* 6*d. net. Presented.*

Japan—Earthquakes. **Omori.**

B. Imp. Earthquake Invest. Committee **6** (1914): 227–258; **7** (1914): 1–216.

The eruptions and earthquakes of the Asama-yama. III. and IV. (Remarks on the seismographical observations at Yunotaira in 1911–1912 and December, 1912, to May, 1914). By Dr. F. Omori. *Sketch-maps, Diagrams, and Illustrations.*

Malay Archipelago—Art. **Loebèr**

Textiele Versieringen in Nederlandsch-Indië. Door J. A. Loebèr. (Kolonial

Instituut Amsterdam.) Amsterdam: J. H. de Bussy, 1914. Size 8½ × 5½, pp. 79. *Illustrations.*

Malay Archipelago—Celebes. ———

Ts. K. Nederl. Aardr. Gen., II. Ser. **31** (1914): 475–500.

De Grensstreken tusschen Loewoe en Mamoedjoe in Centraal-Celebes. *Map.*

Malay Archipelago—Flores—Ethnology. **Stapel.**

Ts. Indische Taal-, Land- en Volkenkunde **56** (1914): 148–187.

Het Manggĕraische Volk (West-Flores). Een en ander over afkomst, geschiedenis, zeden en gewoonten, godsdienst, enz. Door H. B. Stapel. *Illustration.*

Malay Archipelago—Java—Volcano. **van Gent.**

Ts. K. Nederl. Aardr. Gen., II. Serie, **31** (1914): 518–521.

De G. Sĕmeroe. By L. F. van Gent. *Illustrations.*

Mongolia—Lamaism. *J.R. Asiatic S.* (1914): 847–900. **Binsteed.**

Life in a Khalkha Steppe Lamasery. By Lieut. G. C. Binsteed. *Plan and Illustrations.*

Philippines—Medical. *Philippine J. Sc.* **9** (1914): Sec. B, 199–218. **Calderon.**

Some data concerning the medical geography of the Philippines. By Fernando Calderon.

Russia—Caucasus. *M. Kaukasischen Museums* **7** (1913): 351–434. **Shelkovnikoff.**

Eine Reise nach Svanetien im Sommer 1911. By A. B. Schelkovnikov. *Illustrations.* [In Russian.]

AFRICA.

Abyssinia—Ethnology. **Rossini.**

Rendiconti R.A. Lincei, Cl. Sci. Morali, etc., Ser. V. **22** (1913): 397–463.

I Mekan o Suro nell' Etiopia del sud-ovest, e il loro linguaggio. By Carlo Conti Rossini.

East Africa—Historical. *United Empire* **5** (1914): 733–744. **Maugham.**

The early history of the East African coast. By R. C. F. Maugham.

Fernando Po. *B.R.S.G. (Madrid) Rev. G. Col. y Merc.* **11** (1914): 49–55. ———

El ferrocarril de Fernando Póo: I.–Anteproyecto de la red insular. II.–La zona del Noroeste de la isla.

See Monthly Record, *ante*, p. 78.

German East Africa—Railway. *Koloniale Monatsblätter* **16** (1914): 302–320. **Henoch.**

Die Tanganjikabahn. Von Hubert Henoch. *Portraits.*

NORTH AMERICA.

Canada—Historical. **Lescarbot and Grant.**

The history of New France. By Marc Lescarbot. With an English translation, notes, and appendices by W. L. Grant. Vol. 3. (The publications of the Champlain Society, vol. 11.) Toronto, 1914. Size 10 × 6½, pp. xviii. and 556. *Map.*

Canada—Nova Scotia—Geology. **Malcolm.**

Canada. Department of Mines, Geological Survey Branch, Memoir No. 20 E. Goldfields of Nova Scotia. By W. Malcolm. Ottawa, 1912. Size 10 × 6½, pp. xvi. and 332. *Maps, Plans, Illustrations, and Sections.*

Canada—Quebec—Geology. **Wilson.**

Canada, Department of Mines, Geological Survey. Memoir 39. Kewagama lake map-area, Quebec. By M. E. Wilson. Ottawa, 1913. Size 10 × 6½, pp. vi. and 139. *Map and Illustrations.*

Canada—Survey. **Department of the Interior.**

Department of the Interior. Annual report of the Topographical Surveys Branch, 1912–13. Ottawa, 1914. Size 10 × 6¼, pp. 226. *Illustrations. Maps in separate case. Presented.*

Mexico—Texcoco Lake. **Schwarz.**

Mem. y Rev. S. Cient. "Antonio Alzate" **33** (1914): 251–254, 255–261.

Les travaux publics et l'agriculture au Mexique. Le desséchement du lac de Texcoco, par Manuel Schwarz. *Illustrations.*

United States—Colorado. **Kolb.**

Through the Grand Canyon from Wyoming to Mexico. By E. L. Kolb. With a foreword by Owen Wister. New York: The Macmillan Comp., 1914. Size 8 × 5½, pp. xx. and 344. *Sketch-map and Illustrations. Price* 8*s.* 6*d. net. Presented.*

CENTRAL AND SOUTH AMERICA.

Andes. **Colditz.**

Aus den hohen Anden Süd-Amerikas. Vortrag, gehalten am 5. März 1914 in der Aula der Kgl. Kriegsakademie zu Berlin von R. von Colditz. (Veröffentl. Deutsch-Argentinischen Centralverbandes zur Förderung wirtschaftlicher Interessen, Heft 10.) Berlin, 1914. Size 9 × 6, pp. 35.

Andes—Nieve penitente. **Keidel.**

Geol. Charakterbilde (Stille) 21 *Heft* (1914): 6 *plates with text.*

Büsserschnee in den argentinischen Anden. Von H. Keidel. *Illustrations.*

Some of the best representations of the phenomenon that have appeared.

Argentine Republic—Andes. *American J. Sc.* **38** (1914): 309–330. **Palmer.**

Geological notes on the Andes of Northwestern Argentina. By Harold S. Palmer. *Illustrations and Sections.*

Argentine Republic—Geology. **Bodenbender.**

B.A. Nac. Ciencias **19** (1911): No. 1, pp. 220.

Constitución Geológica de la Parte Meridional de la Rioja y Regiones Limitrofes, República Argentina. Por el Dr. Guillermo Bodenbender. *Map.*

Argentine Republic—Parana. **Repossini.**

B. Obras Públicas, República Argentina **7** (1912): 163–186; **8** (1913): 33–102.

Memoria sobre el rio Paraná. By J. Repossini.

Bolivia—Lake Titicaca. *B.S.G. La Paz* **11** (1913): 59–122. **Sans.**

Escursión á las Islas de Titicaca y Coati en Bolivia, por Fr. Rafael Sans.

Reproduces a document of which a few copies only were printed in 1884.

Bolivia—Potosi. *B.S.G. Potosí* **1** (1913): 6–17. ———

Relación del cerro de Potosí y su descubrimiento.

Brazil. **Roosevelt.**

Through the Brazilian wilderness. By Theodore Roosevelt. London: John Murray, 1914. Size 9½ × 6, pp. xiv. and 374. *Maps and Illustrations. Price* 18*s. net. Presented.*

POLAR REGIONS.

Antarctic—Ice. *G. Teacher* **7** (1914): 359–368. **Priestley.**

Antarctic ice. By Raymond E. Priestley. *Sketch-map, Section, and Illustrations.*

Antarctic—Meteorology. **Barkow.**

Vorläufiger Bericht über die meteorologischen Beobachtungen der Deutschen Antarktischen Expedition 1911–12. Von E. Barkow. (Veröffentl. K. Preuss. Meteorolog. Inst., Nr. 265. Abhandl. Bd. IV. Nr. 11.) Berlin: Behrend & Co., 1913. Size 13 × 10½, pp. 11. *Illustrations. Price M.*1.50.

Antarctic—Scott Expeditions. **Scott and Turley.**

The voyages of Captain Scott. Retold from 'The Voyages of the *Discovery*,' and 'Scott's last Expedition.' By Charles Turley, with an Introduction by Sir J. M. Barrie, Bart. London: Smith, Elder & Co., 1914. Size 8 × 5, pp. viii. and 440. *Map and Illustrations. Price* 6*s. net. Presented.*

Antarctic—Wilkes Expedition. **Feipel.**

The Wilkes exploring expedition. Its progress through half a century, 1826–1876. By Louis N. Feipel. (From *U.S. Naval Inst. Proc.*, Vol. 40, No. 5, 1914.) Annapolis, M.D., 1914. Size 9 × 6, pp. 1323–1350. *Sketch-map.*

An attempt to make the Wilkes expedition better known to the public.

Arctic—Geology. **Backlund and Tolmacheff.**

B.A. Imp. Sc. St. Pétersbourg, VI. Ser., 1914: 727–736.

Aperçu sur quelques roches recueillies en 1913 par l'Expédition Hydrographique de l'Océan Glacial du Nord. By H. Backlund and I. Tolmačev. *Map and Illustrations.* [In Russian.]

Arctic—Kara sea. **Lied.**

Steam Navigation of the *Correct* in the Kara Sea into the mouth of the Yenisei in 1913. By J. L. Lied. [N.P., N.D.] Size 10 × 6, pp. 24. *Map and Illustrations.* [In Russian.]

Arctic—Meteorology. **Wegener and Brand.**

Meddelelser om Grønland **42** (1912): 115–122, 129–355, 453–462.

Meteorologische Beobachtungen während der Seereise 1906 und 1908. Von Alfred Wegener. *Illustrations.*

Meteorologische Terminbeobachtungen am Danmarks-Havn. By the same. *Map and Illustrations.*

Meteorologische Beobachtungen der Station Pustering. Von W. Brand und A. Wegener. *Map and Illustrations.*

Observations during the *Danmark* expedition to Greenland.

Greenland. *G. Ts.* **22** (1913): 85–92. **Bruun.**

Peary Land landfast med Grønland, belyst ved "Danmark-Ekspeditionen," Ejnar Mikkelsen og Knud Rasmussen. By Daniel Bruun. *Facsimiles.*

With facsimile reproduction of documents written by Mylius Erichsen.

Greenland. **Koch.**

Kaptain Koch's Rapport fra Proven. Den danske Ekspedition til Dronning Louises Land og tværsover Nordgrønlands Inlandsis 1912–13, under Ledelse af Kapt. J. P. Koch. (Copenhagen: Axel E. Aamodt, N.D.) Size 10 × 6½, pp. 8. *Maps.* [In German.]

See *Journal*, vol. **42**, p. 548. The detailed maps show the route near the east and west coasts.

Greenland. *G. Ts.* **22** (1914): 183–198. **Rasmussen.**

Foreløbig Beretning om "Den første Thule-Ekspedition," 1912–13. By Knud Rasmussen. *Maps and Illustrations.*

Some account of this expedition was given in vol. **42**, p. 546. One of the maps shows the surroundings of Danmark and Independence Fiords in detail.

Greenland—Archæology. *Meddelelser om Grønland* **51** (1914): 81–101. **Stephensen.**

Nye Fund af Nordboruiner i Østerbygden og Bemærkninger om nogle af de gammelkendten. Af K. Stephensen, 1913. *Illustrations.*

MATHEMATICAL GEOGRAPHY.

Cartography. *J.R.S. Arts* **63** (1914): 6–17. **Holdich.**

First Ordinary Meeting. Inaugural address by Colonel Sir Thomas H. Holdich. Chiefly on 'The art of map-making.'

Star-maps. **Clancey.**

A series of monthly and general Star-maps, chiefly for use in latitude 20° N., with a brief explanatory introduction. Prepared by J. C. Clancey. Cork, 1915 [1914]. Size 10 × 7½, pp. 8. *Maps. Presented.*

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Geological history. *G.Z.* **20** (1914): 197–208. **Arldt**

Zur Geschichte der paläogeographischen Rekonstruktionen. Von Th. Arldt.

Geomorphology. *G.Z.* **20** (1914): 185–197. **Hettner.**

Die Vorgänge der Umlagerung an der Erdoberfläche und die morphologische Korrelation. Von Alfred Hettner.

Geophysics. *Ann. Hydrographie* **42** (1914): 141–146, 209–219, 255–270. **Pettersson.**

Studien in der Geophysik und der Kosmischen Physik. Von O. Pettersson. *Diagrams.*

Physiography. **Tarr.**

College Physiography. By Ralph Stockman Tarr. Published under the editorial direction of Lawrence Martin. New York (London): The Macmillan Company, 1914. Size 9 × 6, pp. xxii. and 838. *Sketch-maps, Illustrations, and Diagrams. Price* 15*s. net. Presented.*

GENERAL.

Education—Text-book. **Franklin and Shearmur.**

The Atlas geographies: a new visual atlas and geography combined. Part IV. Commercial atlas geography. By Thomas Franklin and Ernest R. Shearmur. London: W. & A. K. Johnston, 1914. Size 10 × 7½, pp. 232. *Maps and Diagrams. Price 3s. net. Presented.*

Education—Text-book. **Taylor.**

The Oxford Geographies. Edited by A. J. Herbertson. A geography of Australasia. By Griffith Taylor. Oxford: Clarendon Press, 1914. Size 7½ × 5, pp. 176. *Sketch-maps. Price 1s. 6d. Presented.*

Photography—Diary. **Wellcome.**

The Wellcome Photographic Exposure Record and Diary, 1915. London: Burroughs, Wellcome & Co., 1915. Size 5½ × 3, pp. 280. *Illustrations. Presented.*

NEW MAPS.

By E. A. REEVES, *Map Curator*, R.G.S.

EUROPE.

British Isles—Scotland. **Bartholomew.**

Orographical Map of Scotland. Reduced from the Ordnance Survey by J. G. Bartholomew, LL.D. Scale 1 : 253,440 or 1 inch to 4 stat. miles. 4 sheets, each 36 by 28 inches. Edinburgh: John Bartholomew & Co., [1914]. *Price £1 1s. Presented by the Publishers.*

An orographically coloured map of Scotland in four sheets, which, when mounted as one, give an excellent idea of the general relief and leading physical features of the country. Although intended for hanging on walls, there is nothing coarse or diagrammatic in its appearance, and close inspection is necessary to read the large amount of finely executed detailed information which it contains. The orographical tinting has been most carefully executed, but the map has a somewhat sombre appearance as the shades are darker than those usually employed, which as a rule now more or less follow those agreed upon by the committee of the 1 : 1,000,000 International map of the World.

The land contours in feet are as follows: 0–250, 250–500, 500–750, 750–1000, 1000–1500, 1500–2000, 2000–2500, 2500–3000, 3000–3500, and 3500–4000. From 0 to 750 feet shades of green are employed, then from 750 to 3500 shades of brown increasing in intensity with the increasing altitude. Purple is used for land between 3500 and 4000, and all land above 4000 feet is left white. The purple is perhaps a mistake, and it is satisfactory to learn that it is not to be admitted into the revised colour scheme for the 1 : 1,000,000 International map. Depths of the sea are indicated in the usual manner by varying tints of blue. The registration of the colour tints is excellent and the general production of the map most creditable.

Copies of the map may be had without the colour tinting, printed in black and blue only, for the representation of special features; and some copies have been printed showing only the orographical features in colour, without outline or lettering, for the use of teachers of geography.

Central Europe. **Bartholomew.**

Bartholomew's Orographical Map of Central Europe showing political boundaries. Scale 1 : 2,000,000 or 1 inch to 31·56 stat. miles. Size 32 by 40 inches. Edinburgh: John Bartholomew & Co., [1914]. *Price, on cloth, 4s. Presented by the Publishers.*

Extends from lat. 41°–30′ to 55° N. and from long. 5° W. to 22° E. The orographical features are indicated by tints of green, brown and purple at the following metre intervals: 0–100, 100–300, 300–500, 500–1000, 1000–1500, 1500–2000, 2500–3000, 3000–3500, 3500–4000, 4000–4500, and over 4500. The map contains a considerable amount of detail and many place-names. International boundaries are clearly shown in red lines. Plans of the environs of Paris, Hamburg, Berlin, Rome, and Vienna are given as insets.

Europe. **Bacon.**

Contour Wall Map illustrating Military Operations in the Seine and Rhine Basins. Scale 1 : 1,013,760 or 1 inch to 16 stat. miles. Size 36 by 27 inches. London: G. W. Bacon & Co., Ltd., 1914. *Price, on cloth, rollers, and varnished, 7s. 6d. Presented by the Publishers.*

Extends from London to Hamburg and from north of the Kiel canal to the Lake of Geneva. It is clear in style and not overcrowded with names. Relief is approximately shown by the colour layer system, the contour intervals in metres being as follows: below sea-level, 0–100, 100–300, 300–500, 500–1000. Depths of sea 0–20, 20–40, and below 40 metres. The contours have been considerably generalized, and in parts are not so accurate as they might be.

Europe. **Bartholomew.**

Bartholomew's General War Map of Europe and the Mediterranean. Scale 1 : 5,448,960 or 1 inch to 86 stat. miles. Size 25 by 32 inches. Edinburgh: John Bartholomew & Co., [1914]. *Price, on cloth, 2s. Presented by the Publishers.*

A clear and useful map for general reference. No attempt has been made to show relief.

Europe. **Gallois.**

Carte Murale du Théâtre de la Guerre. Par L. Gallois. Scale 1 : 600,000 or 1 inch to 9·5 stat. miles. Paris: Armand Colin, [1914].

A diagrammatic wall map of the western theatre of war, showing principal places in bold lettering; but somewhat obliterated by names of smaller places which might with advantage have been left out. Information of military importance, such as fortified towns and railways of various classes, is given by symbols and colours. German territory is tinted reddish-brown, and it is noticeable that Alsace and Lorraine are not included in this tinting, although a broad dotted international boundary-line parts them from France.

Europe. **Geographical Section, General Staff.**

Map of North-West Europe. Scale 1 : 250,000 or 1 inch to 3·9 stat. miles. Sheets: 1, 2, 4, 5, each 20 by 29 inches. London: Geographical Section, General Staff, War Office, 1914. London agents: E. Stanford, Ltd.; Sifton, Praed, & Co., T. Fisher Unwin. *Price 3s. each sheet. Presented by the Director of Military Operations.*

This map will be specially useful at the present time, as it is on sufficiently large scale and gives enough detail for following the events of the war intelligibly. Sheet No. 2 includes the valley of the Rhine in the neighbourhood of Bonn, Cologne, and Düsseldorf, and extends west as far as Diest and Tirlemont, and south to Liége. No. 4 extends from Mons and Charleroi on the north, to Amiens on the west, and Compiegne on the south. No. 5 adjoins No. 4 to the east and gives Sedan, Luxemburg, Thier, with a small section of the Rhine in the north-east corner. The map is ruled into 2-inch squares, and is printed in colours, contours and roads brown, woods green, water blue, railways black; relief is shown by contours at intervals of 50 metres.

Europe. **Gross.**

The *Daily Telegraph* Display War Map. Scale 1 : 1,200,000 or 1 inch to 18·9 stat. miles. By Alexander Gross. Size 58 by 78 inches. *Price, mounted on rollers, 50s.* —The *Daily Telegraph* War Maps, Nos. 1, 2, 3, 4. With Index. By Alexander Gross. *Price, mounted on rollers, 5s. 6d. each.* London: Geographia, Ltd., 1914. *Presented by the Publishers.*

Europe. **Johnston.**

The European War, 1914. Map illustrating "The Western Campaign." Scale 1 : 1,175,000 or 1 inch to 18·5 stat. miles. Edinburgh & London: W. & A. K. Johnston, Ltd., 1914. *Price 1s. 6d. net. Presented by the Publishers.*

Another of the numerous war maps now being issued. International boundaries are given by bold red lines, and relief is indicated approximately by colour tinting. A general map of Europe on a small scale, and enlarged plans of Berlin and Paris with their environs appear as insets. The map also contains a table giving area and population of the countries and capitals of Europe.

Europe. **Philip.**

Philip's Contour War Map of Europe. Scale 1 : 4,000,000 or 1 inch to 63 stat. miles. Size 28 by 39 inches. London: George Philip & Son, Ltd., 1914 *Price 1s. net. Presented by the Publishers.*

An orographical map showing relief in the coloured layer system, in shades of green, yellow, and brown, at the following contour intervals in feet: below sea-level, 0–600, 600–1200, 1200–3000, 3000–6000, and above 6000. The sea below 600 feet is shown by light blue, and below that depth by a darker tint of blue. The map does not include the northern parts of Norway, Sweden, or Russia. International boundaries are boldly drawn in red.

Europe. **Philip.**

Philip's Large-scale Strategical War Map of Europe, Western Area. With complete Index. Scale 1:633,600 or 1 inch to 10 stat. miles. Size 36 by 46 inches. London: G. Philip & Son, Ltd., 1914. *Price 6s. net, mounted on rollers and varnished. Presented by the Publishers.*

Shows clearly, by colours and symbols, means of communication, fortresses and fortified places, airship depôts, and other information useful for following the events of the war. Woods and forests are in green. General relief of the land is indicated by brown shading. Insets of the road between Verdun and Toul, and between Epinal and Belfort are given on enlarged scales, as are also plans of the environs of Paris, Antwerp, Metz, Strassburg, Cologne, Coblence, and Mayence. A useful alphabetical index to place-names accompanies the map as a separate pamphlet.

France. **Barrère.**

Carte Touriste de France. Dressée avec le concours du Touring-Club de France. Scale 1:400,000 or 1 inch to 6·3 stat. miles. Sheets: II. Lille; III. Bruxelles; V. Paris; VI. Nancy; IX. Dijon. Size 21 by 33 inches. Paris: Henry Barrère, 1914.

ASIA.

Malay Archipelago—Sumatra. **Topographical Bureau, Batavia.**

Overzichtskaart dan het eiland Sumatra. Scale 1:2,000,000 or 1 inch to 31·5 stat. miles. Size 27 by 25 inches. Batavia: Topographische Inrichting, 1913.

Malay Archipelago—Sumatra. **Topographical Bureau, Batavia.**

Schetskaart van Residentie Palembang. Scale 1:300,000 or 1 inch to 4·7 stat. miles. 4 sheets, each 26 by 32 inches. Batavia: Topographische Inrichting, 1914.

An official map of the Palembang residency in Eastern Sumatra, opposite the island of Banka. To a great extent this part of the island has not yet been accurately surveyed, and the mapping of considerable areas is based upon route traverses and more or less approximate sketches. However, such material as exists has been utilized in the production of this map, which, like others published by the same department, is clearly drawn and carefully printed in colours. Relief is shown by vertical hachures in brown, water blue, roads and tracks by red lines of varying breadth and style, according to their character. The size and importance of towns and villages, anchorages, fortifications, telegraphs, and other information is given by symbols and tables.

AFRICA.

German South-West Africa. **Government Printing Office, Pretoria.**

War Map of German South-West Africa. Scale 1:1,900,800 or 1 inch to 30 stat. miles. Size 33 by 27 inches. Pretoria: Government Printing Office, 1914. *Price 1s.*

A roughly executed map, evidently hurriedly produced for use in the present war. In addition to German South-West Africa, considerable portions of the adjacent parts of Bechuanaland and the Cape of Good Hope are included.

AMERICA.

Canada. **Dept. of the Interior, Ottawa.**

Standard Topographical Map of Canada. Scale 1:250,000 or 1 inch to 3·95 stat. miles. Sheet 8 S.W., Manitoulin, Ontario. Size 27 by 20 inches. Ottawa: Department of the Interior, 1914. *Presented by the Department of the Interior, Ottawa.*

This sheet extends in latitude from 45° to 46° 30′, and in longitude from 81° 30′ to 83° W.

Canada—Saskatchewan. **Dept. of Public Works.**

Map of the Southern part of the Province of Saskatchewan. Scale 1:633,600 or 1 inch to 10 stat. miles. Corrected to January 1, 1914. 2 sheets, each 30 by 48 inches. Saskatoon: Department of Public Works, 1914. *Presented by F. McClure Sclanders, Esq.*

United States. **Dept. of the Interior, Washington.**

Panoramic View of the Glacier National Park, Montana. Scale 1 : 187,500 or 1 inch to 29·5 stat. miles. Washington: Department of the Interior, [1914]. *Presented by the Department of the Interior, Washington.*

A somewhat roughly executed diagrammatic map, showing relief by green and reddish tinting, accentuated by shading.

AUSTRALIA.

Victoria. **Geological Survey of Victoria.**

Geological Survey of Victoria. Scale 1 : 31,680 or 2 inches to 1 stat. mile. Sheets: Myrtleford; Stanley. Size 20 by 18 inches. Geological Sketch-map of the Werribee Gorge and adjacent country. Scale 1 : 63,360 or 1 inch to 1 stat. mile. Size 8 by 9 inches. Melbourne: Geological Survey of Victoria, 1914. *Presented by the Geological Survey of Victoria.*

ATLANTIC OCEAN AND ISLANDS.

Madeira. **Power.**

General Map of the Island of Madeira, constructed by Charles A. Power from other maps, greatly improved, corrected, and brought up to date, 1914. Scale 1 : 100,000 or 1 inch to 1·6 stat. miles. Size 12 by 24 inches. London: Edward Stanford, Ltd., 1914. *Price* 1*s.* 6*d.*

A general map of the island, with hill shading in brown. Roads are shown by red and footpaths by black lines, while, amongst other information, pure-water springs are indicated by a special symbol. The map has been prepared to accompany Mr. Power's recently published book, 'The Island of Madeira,' and is accompanied by an index to place-names.

GENERAL.

World. **Philip.**

Daily Mail World Map of War and Commerce. Equatorial scale 1 : 36,000,000 or 1 inch to 568·2 stat. miles. Size 19 by 38 inches. London: George Philip & Son, Ltd., 1914. *Price* 1*s. net. Presented by the Publishers.*

A coloured map of the world on Gall's stereographic projection showing principal railways, steamer routes, cables, coaling stations, international boundaries, etc. Statistical information is graphically represented by diagrams.

CHARTS.

Atlantic, North, and Mediterranean. **Meteorological Office.**

Monthly Meteorological charts of the North Atlantic and Mediterranean, December, 1914. London: Meteorological Office, 1914. *Price* 6*d. each. Presented by the Meteorological Office.*

Atlantic Ocean. **U.S. Hydrographic Office.**

Pilot chart of the North Atlantic Ocean, November, 1914. Ditto, December, 1914, January and February, 1915. Washington: U.S. Hydrographic Office, 1914. *Presented by the U.S. Hydrographic Office.*

Indian Ocean. **U.S. Hydrographic Office.**

Pilot chart of the Indian Ocean, December, 1914; January, 1915. Washington: U.S. Hydrographic Office, 1914. *Presented by the U.S. Hydrographic Office.*

Pacific Ocean. **U.S. Hydrographic Office.**

Pilot chart of the North Pacific Ocean, December, 1914; January, 1915. Ditto, South Pacific Ocean, December, 1914, January and February, 1915. Washington: U.S. Hydrographic Office, 1914. *Presented by the U.S. Hydrographic Office.*

N.B.—It would greatly add to the value of the collection of Photographs which have been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

Maps to illustrat

by

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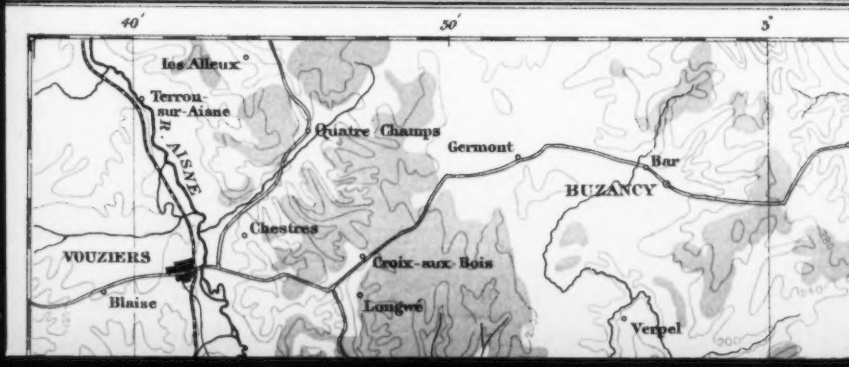
THE GEOGRAPHY



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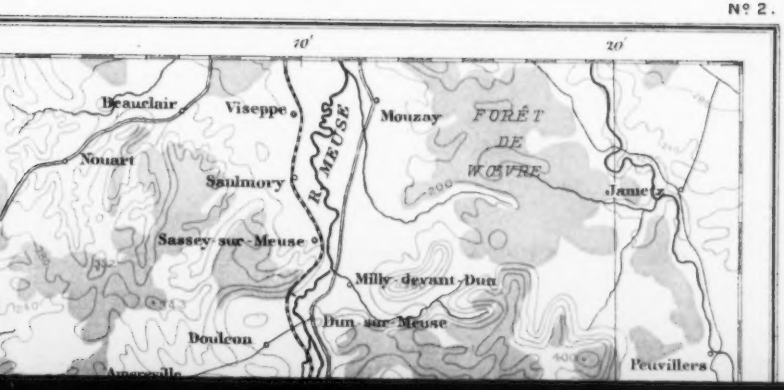

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Oudenburg
Jabbeke
Zedelghem
Erneghem
Aertrycke
St. Pierre Capelle
Leke
Couckelaere
Keyem
Beerst
Bovekerke
THOUROUT
Cortemarck
Zarren
DIXMUDE
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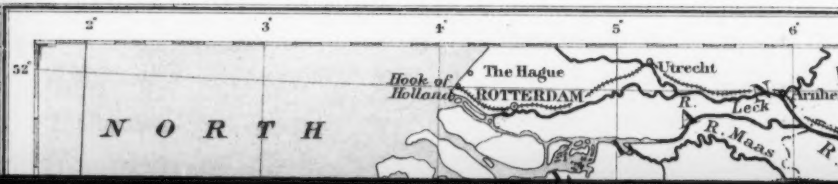
Roads
Railways
Marsh land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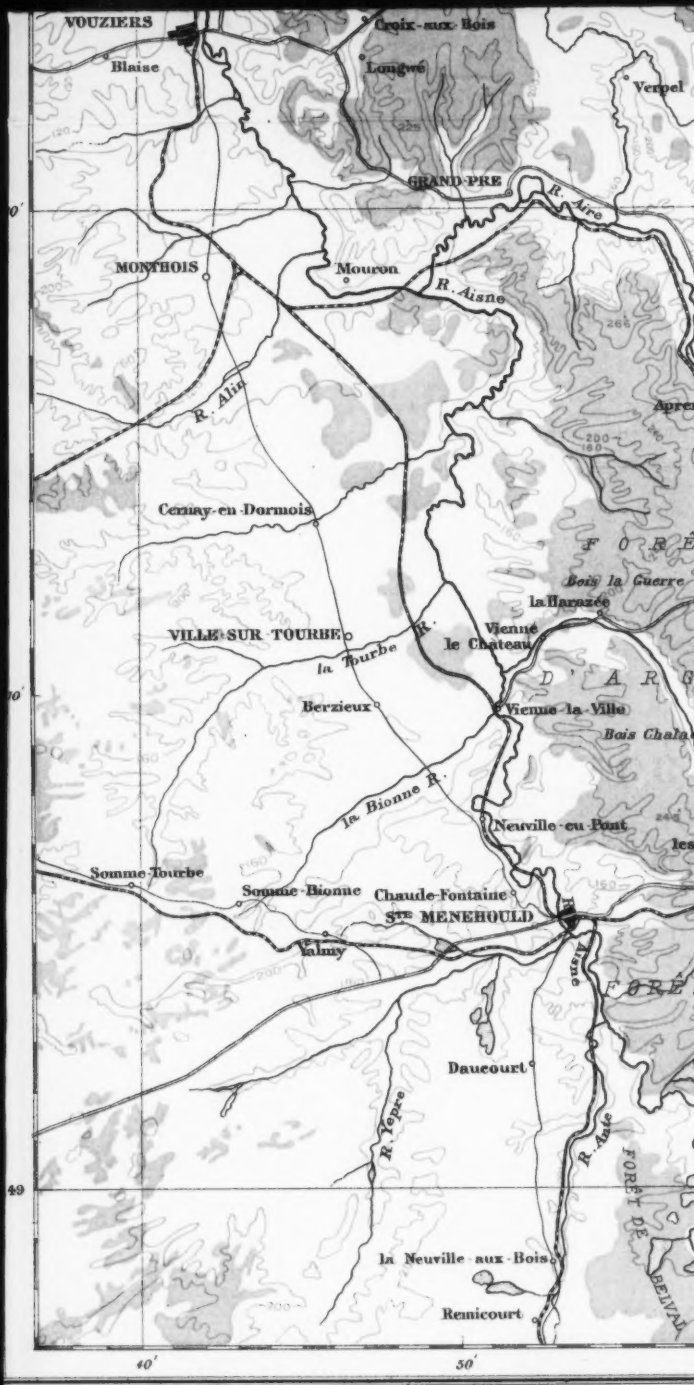
VOUZIERS
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Blaise
Longwé
Verpel
GRAND-PRE
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MONTHOIS
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FORÊ
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la Harazée
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D'ARG
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Bois Chala
la Bionne R.
Neuville-en-Pont
Somme-Tourbe
Somme-Bionne
Chaude-Fontaine
Ste MENEHOULD
Talmy
Daucourt
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Railways
Main Roads
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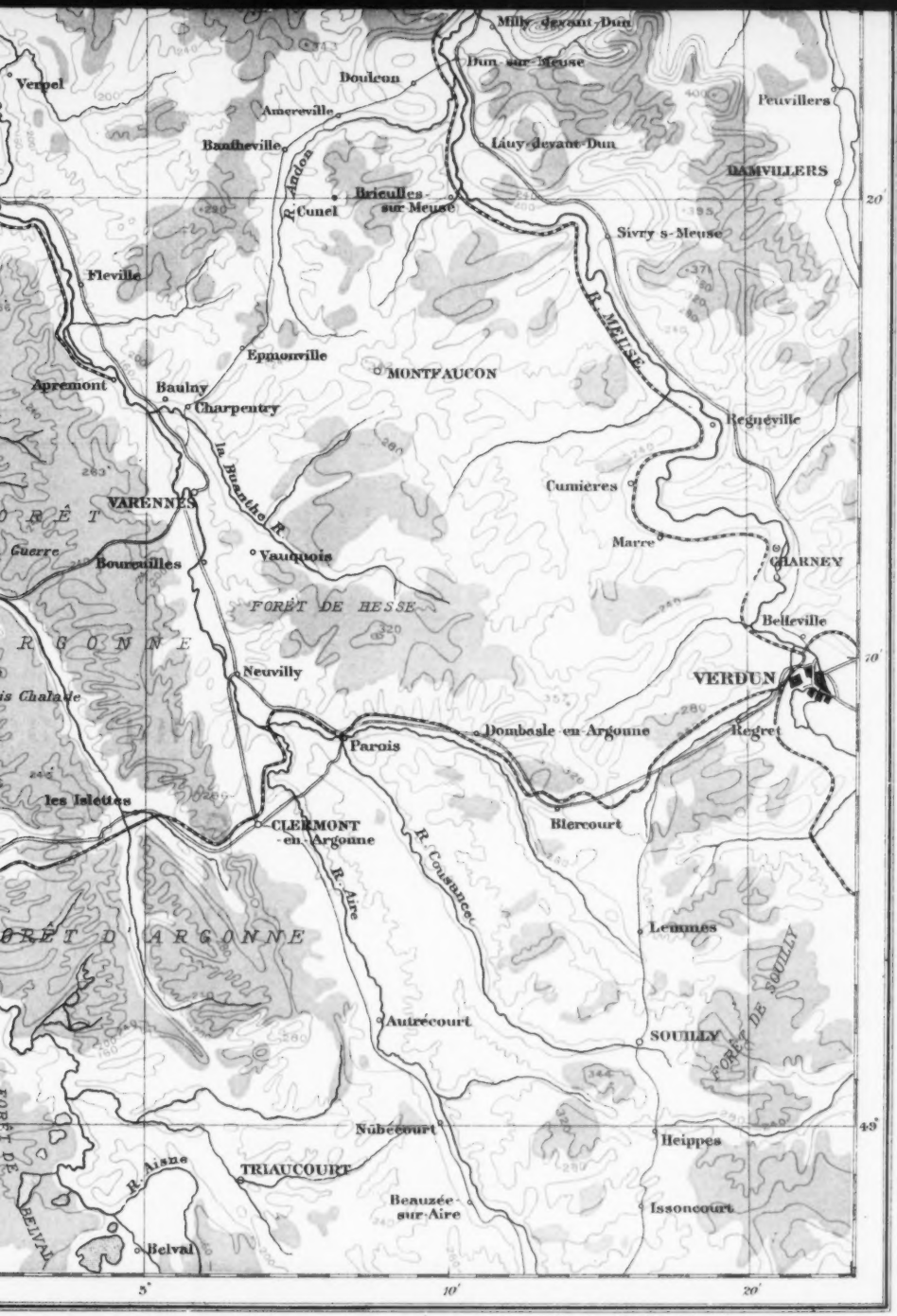

Forests

Contours every 40 Metres · 131·24 feet

Scale. 1: 250,000 or 1 inch · 3·94 Statute Miles

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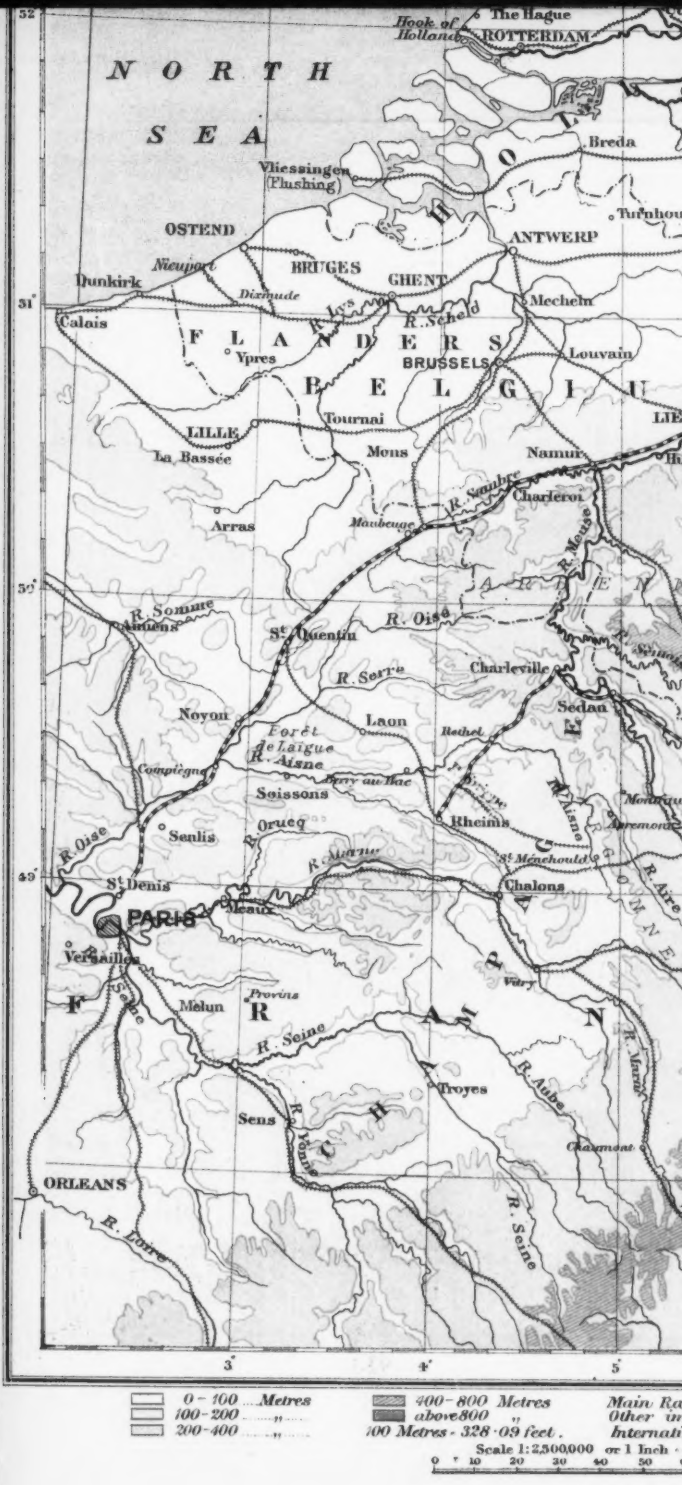
Published by the Royal Geographical Society.


NORTH SEA
Hook of Holland
The Hague
ROTTERDAM
Breda
Vlissingen (Flushing)
OSTEND
ANTWERP
Nieuport
BRUGES
GHENT
Dunkirk
Dixmude
Mechelin
Calais
R. Lys
R. Scheld
FLANDERS
Ypres
BRUSSELS
Louvain
BELGIUM
Tournai
LILLE
La Bassée
Mons
Namur
R. Sambre
Charleroi
Arras
Maubeuge
R. Meuse
R. Somme
Amiens
St. Quentin
R. Oise
R. Serre
Charleville
Noyon
Laon
Sedan
Forêt de Laigue
R. Aisne
Compiègne
Berry au Bac
Seissons
Rheims
Senlis
Orueq
R. Oise
R. Marne
St. Denis
Meaux
Chalons
PARIS
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Provins
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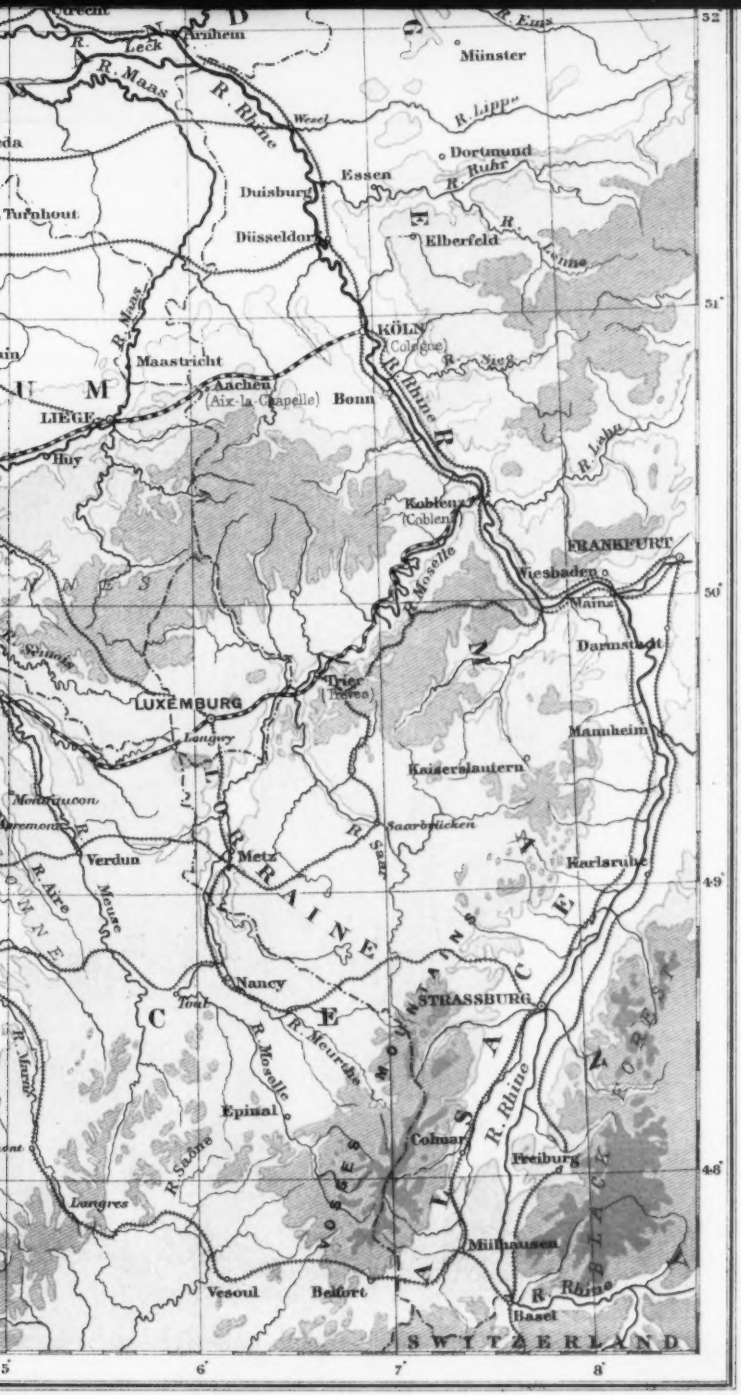


Main Railway lines of German communication

Other important Railways

International Boundaries

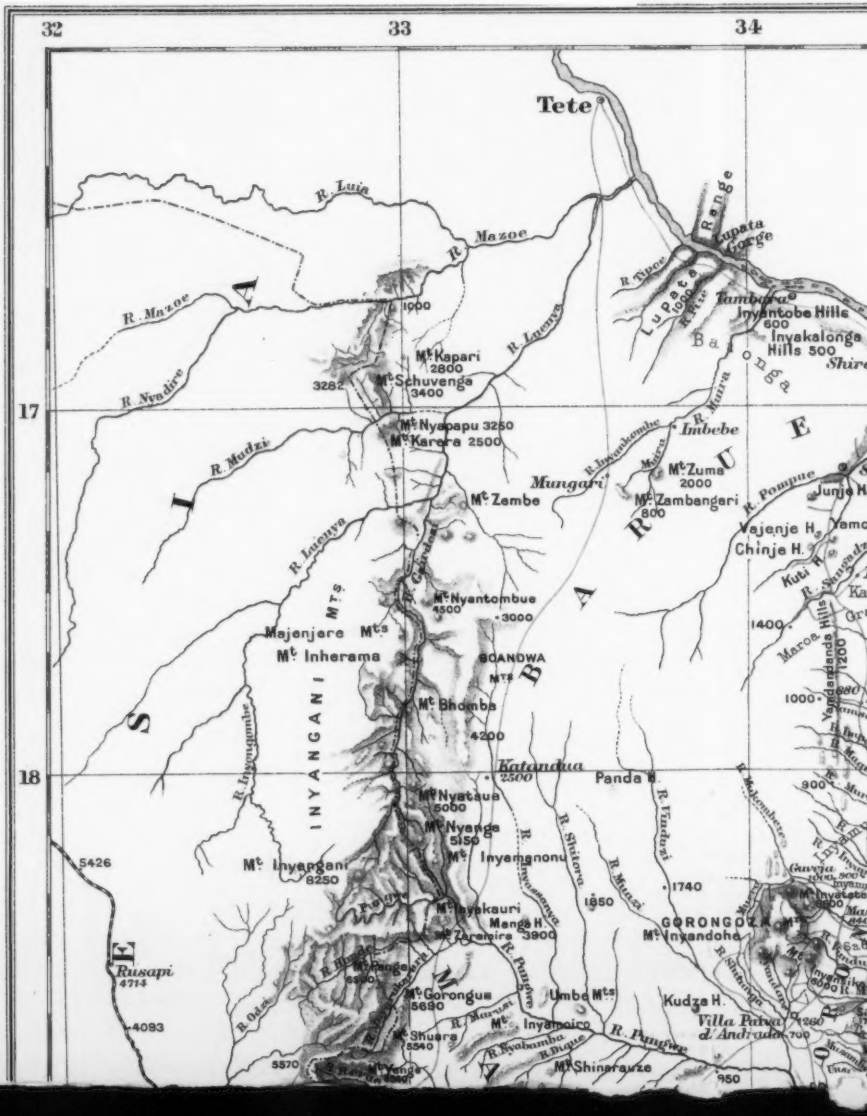
1 Inch = 39·45 Statute Miles

50 60 70 80 90 100

GEOGRAPHY OF THE WAR

BELLOC

This Map is the joint work of Mr. O. E. Thiele and Mr. R. C. Wilson.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E. O. THIELE

Scale. 1:2.000.000 or 1

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NOTE.—This Map has been comp
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and 1810, and a Map of Portuguese
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R. Shire
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Shionde
R. Budza
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Lacerdonia
Shipanga
770
Jujepje
Kunkwe Hill
Panda H.
1000
Umpute
Bunga H.
200
Gumanye Hills
1000
Mazamba 640
SHERINCOMA
PLATEAU
Inkwayri Hills
1480
Maskedes
Immuza
R. Sangwe
R. Dueza
R. Kapa
R. Inyamapate
R. Inyamchangwe
R. Inyamitsa
R. Inyamitsa
R. Inyamitsa

36 37

TUGUESE EAST AFRICA
between the
MBEZI AND THE SABI RIVERS
by
E. O. THIELE M.Sc., F.G.S.

Scale. 1:2,000,000 or 1 Inch = 31·56 Statute Miles.

10 0 10 20 30 40 50 60

Reference.

Survey Routes
Tracks not traversed
Native districts ..... Shimoio
Railway .....
Residence of Commandant ..... ⊙
Heights in feet.

17

NOTE.—This Map has been compiled from Mr. Thiele's compass traverses mbined with, and adjusted to, previously existing cartographical material, luding the Rhodesia-Portuguese Boundary Survey, Admiralty Charts Nos. 648 d 1810, and a Map of Portuguese East Africa, 1:1,000,000, published by the nisterio da Marinha e Colonias, Lisbon.

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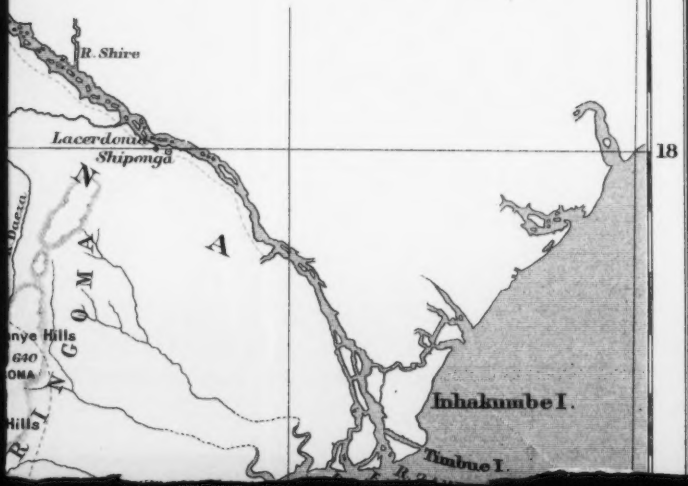

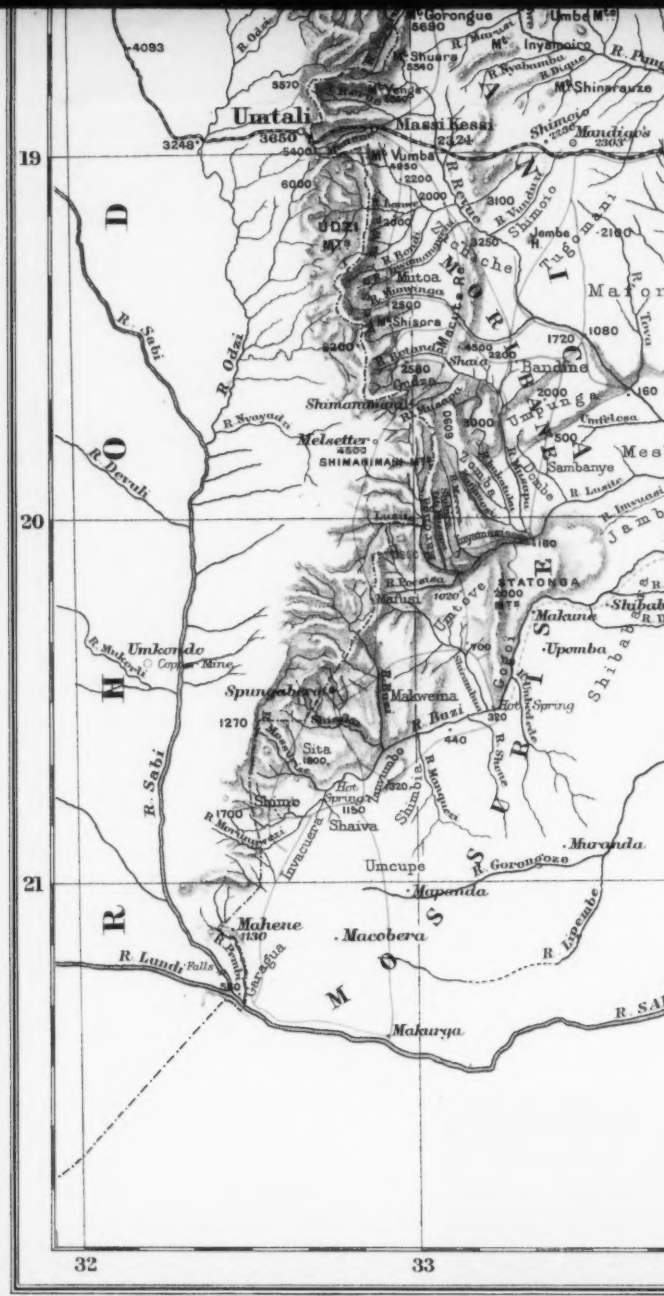
Umtali
Massi Kessi
Mt. Vumba
UDZI MTS
Mutoa
Shisora
Melsetter
SHIMASIMAZI MTS
Umkondo
Copper Mine
Spungabera
Sita
Shimo
Shaiva
Mahene
Macobera
Makurya
Umcupe
Mapanda
Maranda
Makaue
Upemba
Makwena
Hot Spring
Bandine
Sambanye
STATONGA
Malusa
Mt. Shiorouze
Mt. Inyamaico
Mt. Shuara
Mt. Gorongue
Umbe Mts
Mandiqua's
Jembe
Tugonsi
Mesa
Jambe
Shibabe
Gorai
Shimoio
Shimoio
Inyamaico
Inyamboo
Shimbia
Invacuera
Lundi Falls
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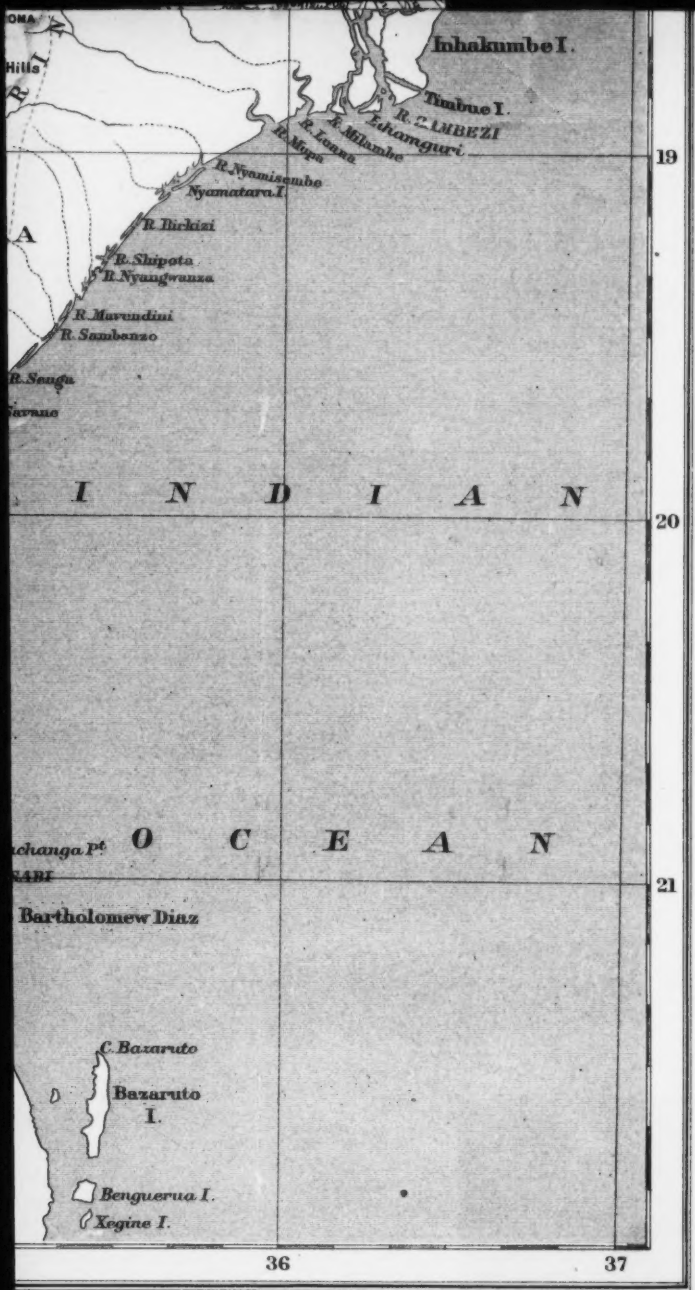

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